The syllabus of the discipline

Communication network design automation

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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	Administration of Windows operating systems
Number of ECTS credits	4,5
Discipline structure (distribution by types and hours of study)	36 hours - 18 lectures, 6 hours - 3 practical classes, 20 hours - 5 laboratory classes, 14 hours - 7 consultations, 36 hours - homework, **type of control**: exam
Schedule (terms) of studying the discipline	3rd year, V semester
Prerequisites for studying the discipline	students must study the discipline: electrodynamics, theory of electric circuits, higher mathematics
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: to formulate and solve problems of analysis, synthesis, optimization and modeling on a computer for various devices, systems and telecommunication networks; choose a rational work program or software package to solve the problem of computer-aided 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 - to teach students modern methods of designing devices, systems and telecommunication networks using computers.

Content

Content module 1. General information about computer-aided design systems.

Topic 1. Stages and stages of design of complex technical systems. System approach - the basis of system design. Formulation of the problem of optimal design. Problems of discrete choice, optimization of structure and parameters of systems, modeling of systems. The role of computers in system design. Possibilities of automation at different stages of design.

Topic 2. The structure and principle of the communication network. Possibilities of designing devices, systems and telecommunication networks using computers. Features of design automation at the level of functional and schematic diagrams, structural and system level, at the level of communication network.

Content module 2. Scalar and vector optimization methods.

Topic 1. Formulation of the optimization problem of design. Optimality criteria, target functions and constraints. Permissible and optimal design solutions.

Topic 2. Classification of types of optimization problems. Optimization of parameters and structure, discrete system selection.

Topic 3. Scalar optimization of functions of one variable. Conditions of existence and methods of finding the extremum of a function. Solving the problem of conditional optimization of functions in the presence of constraints. Examples of optimization problems in the design of telecommunication systems and networks.

Topic 4. Scalar optimization of functions of many variables. Method of linear, nonlinear and dynamic programming in solving optimization problems. Gradient optimization methods.

Topic 5. Multicriteria design problems. Pareto optimality.Methods of finding optimal design solutions - search method, performance method, weight method. Multidimensional potential characteristics and multidimensional diagrams of exchange of quality indicators of systems.

Topic 6. Methods of narrowing the set of Pareto-optimal solutions using value functions, based on the theory of blurred sets and lexographic ordering of quality indicators.

Topic 7. Examples of solving optimization problems in the design of telecommunication systems and networks.

Content module 3. Methods of modeling devices, systems and communication networks on a computer.

Topic 1. Types of modeling of complex technical systems. Basic principles of transition to the description of devices, systems and telecommunication networks by mathematical models.

Topic 2. Classification of mathematical models. Linear and nonlinear models. Deterministic and probabilistic models. Principles of construction of simulation models: process, structural, double.

Topic 3. Probabilistic approach to building mathematical models of telecommunication devices, systems and networks. Examples of the use of probabilistic models of processes, signals, interference in the modeling of devices, systems and telecommunication networks.

Topic 4. Computer simulation as a powerful tool for automating the design of telecommunication devices, systems and networks. The main stages of computer simulation. Methods of mathematical description of signals - carrier method, envelope method, information parameter method. Method of statistical modeling of computer systems.

Topic 5. Basic principles of computer modeling of random elements. Methods of computer modeling of random variables and vectors with given probabilistic characteristics, which are widely used in the construction of mathematical models of devices, systems and telecommunication networks.

Topic 6. Methods of computer simulation of random processes with given probabilistic characteristics, which are widely used in construction of mathematical models of telecommunication devices, systems and networks.

Topic 7. Method of statistical modeling of computer systems. Experiment planning. Processing of statistical test results.

Content module 4. Use of software packages in automated design of communication systems and networks.

Topic 1. Overview of the capabilities of different programming languages and software packages to automate the design of communication systems and networks.

Topic 2. Purpose and main features of software packages MathLab, MathCard, Electronics Workbench .

Topic 3. Characteristics of professional software packages such as OPNET for modeling and optimization of communication networks.

Learning outcomes of higher education

As a result of studying the discipline, students must:

KNOW: the principles of creation and operation of computer-aided design systems; basic methods of optimization and modeling of devices, systems and telecommunication networks on a computer.

BE ABLE TO: formulate and solve problems of analysis, synthesis, optimization and modeling on a computer for various devices, systems and telecommunication networks; choose a rational work program or software package to solve the corresponding problem of computer-aided design.

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

To assess the student's work during the semester, the final rating score Q_{sem} is used, which is calculated as the sum of marks for different types of classes and control activities. For control testing, the OpenTest 2 computer testing system is used.

Type of lesson / control measure	Rating
Fulfillment and defense of Lb No. 1, 2, 3	8x3=24
Completion of tasks for software No. 1, 2	4x2=8
Control testing 1	6
Implementation and protection of the IDZ No. 1	12
Checkpoint 1	50
Fulfillment and defense of LB No. 4, 5	8x2=16
Control testing 2	6
Completion of tasks for software No. 3	4
Control testing 3	8
Implementation and protection of the IDZ No. 2	12
Checkpoint 2	50
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.

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

<table>
<tr><td rowspan="2">The sum of points for all types of educational activities</td><td rowspan="2">ECTS assessment</td><td colspan="2">Score on a national scale</td></tr>
<tr><td>for exam, course project (work), practice</td><td>for offset</td></tr>
<tr><td>90 – 100</td><td>A</td><td>perfectly</td><td rowspan="5">credited</td></tr>
<tr><td>82-89</td><td>B</td><td rowspan="2">fine</td></tr>
<tr><td>74-81</td><td>C</td></tr>
<tr><td>64-73</td><td>D</td><td rowspan="2">satisfactorily</td></tr>
<tr><td>60-63</td><td>E</td></tr>
<tr><td>35-59</td><td>FX</td><td>unsatisfactory with the possibility of reassembly</td><td>not credited with the possibility of re-assembly</td></tr>
<tr><td>0-34</td><td>F</td><td>unsatisfactory with mandatory re-examination</td><td>not credited with compulsory re-study of the discipline</td></tr>
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Methodical support

Basic literature

1. Beiko Y.V., Bublyk B.N., Zynko P.N. Metody y alhorytmy reshenyia zadach optymyzatsyy. Spravochnoe posobye. - K.: Vyshcha shkola, 1983.
2. Viazghyn V.A., Fedorov V.V. Matematycheskye metody avtomatyzyrovannoho proektyrovanyia: Uchebnoe posobye. - M.: Vysshaia shkola, 1989.
3. Dmytryev A.N., Ekupov N.D., Shestopalov A.M., Moyseev Yu.H. Mashynnye metody rascheta y proektyrovanyia system elektrosviazy y upravlenyia. - M.: Radyo y sviaz, 1990.
4. Molchanov A.A. Modelyrovanye y proektyrovanye slozhnykh system: Uchebnoe posobye. - K.: Vyshcha shkola, 1988.
5. Nohyn V.D., Protodiakonov Y.O., Evlampyev Y.Y. Osnovy teoryy optymyzatsyy: Uchebnoe posobye. - M.: Vysshaia shkola, 1986

Supporting literature

6. Yonnyn H.L., Sedol Ya.Ia. Statystycheskoe modelyrovanye system teletrafyka. - M.: Radyo y sviaz, 1982.
7. Borysov Iu.P., Tsvetkov V.V. Matematycheskoe modelyrovanye radyotekhnycheskykh system y ustroistv. - M.: Radyo y sviaz, 1985.
8. Sovetov V.Ia. Modelyrovanye system: Uchebnoe posobye. - M.: Vysshaia shkola, 1988.

Methodical instructions for different types of classes

1. Metodychni vkazivky do laboratornykh rabit z dystsypliny «Avtomatyzatsiia proektuvannia system zviazku»/Uporiadnyky V.M. Bezruk, O.O. Kolesnykov, I.V Korsun. - Kharkiv: KhNURE, 2004.
2. Metodychni vkazivky z samostiinoi roboty z dystsypliny «Avtomatyzatsiia proektuvannia system zviazku»/Uporiadnyk V.M. Bezruk. - Kharkiv: KhNURE, 2006.
3. Metodychni vkazivky do praktychnykh zaniat z dystsypliny «Avtomatyzatsiia proektuvannia system zviazku» / Uporiadnyk V.M. Bezruk. - Kharkiv: KhNURE, 2007.

Information support

Laboratory work is performed on a computer with the help of specially designed software packages that allow not only to conduct research on relevant topics of the discipline, but also to gain practical skills in working with various software packages used in automated design of telecommunications systems and networks.