The syllabus of the discipline

Fundamentals of systems theory

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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	Fundamentals of systems theory
Number of ECTS credits	4
Discipline structure (distribution by types and hours of study)	24 hours - 12 lectures, 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; 4th year, VI semester
Prerequisites for studying the discipline	Basic knowledge of: 1. Higher mathematics. 2. Theory of electric circuits and signals. 3. Fundamentals of circuitry.
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 own: 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; PRN3. Ability to apply knowledge in the field of informatics and modern information technologies, computer and microprocessor technology and programming, software for solving specialized problems and practical problems in the field of professional activity; PRN4. Ability to participate in the creation of application software for elements (modules, blocks, nodes) of telecommunication systems, infocommunication, telecommunication networks, radio systems and television and radio broadcasting systems, etc .; 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 engineering systems and television and radio broadcasting systems, etc .; PRN8. Ability to apply modern achievements in the field of professional activity in order to build advanced telecommunication systems, infocommunication, telecommunication networks, radio systems and

	television and radio broadcasting systems, etc .; PRN9. Ability to administer telecommunication systems, infocommunication and telecommunication networks; PRN10. Ability to test telecommunication systems, infocommunication, telecommunication networks, radio television and radio broadcasting systems and systems in accordance with technical regulations and other normative documents
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 study and use the provisions of systems theory to study the principles of construction of modern hardware and software systems of telecommunications. The provisions of systems theory are a necessary part of the analysis and construction of complex technical objects.

Content

Content module 1. Basic concepts and terms of systems theory
Topic 1. The concept of physical and abstract systems. The concept of the environment. Signals as functions of time.
Topic 2. Defining the concept of system status, the concept of system input and output.
Topic 3. Graphic representation of systems and components of systems. A method of building a system as a connection of components.

Content module 2. The concept of state as the basis of system analysis
Topic 1. Equations of state. Basic properties of states.
Topic 2. The concept of zero state, steady state and equilibrium state.
Topic 3. The state of the connection systems.

Content module 3. The concept of linear stationary systems
Topic 1. The concept of linear system. The concept of a stationary system.
Topic 2. Properties of a linear system as additivity and homogeneity.
Topic 3. Properties of the input-output-state ratio.

Content module 4. Stability of linear stationary systems.
Topic 1. The concept of system stability. Stability criterion of the Lyapunov and Raus-Hurwitz systems.

Topic 2. The concept of impulse and transient reactions of the system. The concept of the transfer function of the system.
Topic 3. The concept of controllability and observability of the system.

Learning outcomes of higher education

As a result of studying the discipline, students must:

- know: definition of system and system approach; signs and principles of building systems; system classification and system hierarchy; methods of mathematical description of systems; the relationship of input, internal and output parameters of the system; methods of obtaining system characteristics; methods of graphical representation of systems; features of construction of systems from components of the lower level;

- be able to: provide a description of objects in the form of a system; build a system model and receive the results of its action; build the structure of the system and provide it with a graphic image; provide opportunities for system interaction;

- to own: 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; PRN3. Ability to apply knowledge in the field of informatics and modern information technologies, computer and microprocessor technology and programming, software for solving specialized problems and practical problems in the field of professional activity; PRN4. Ability to participate in the creation of application software for elements (modules, blocks, nodes) of telecommunication systems, infocommunication, telecommunication networks, radio systems and television and radio broadcasting systems, etc .; 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 advanced telecommunication systems, infocommunication, telecommunication networks, radio systems and television and radio broadcasting systems, etc .; PRN9. Ability to administer telecommunication systems, infocommunication and telecommunication networks; PRN10. Ability to test telecommunication systems, infocommunication, telecommunication networks, radio systems and television and radio broadcasting systems in accordance with technical regulations and other regulations

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} is calculated as the sum of grades for different types of classes and control activities.

Type of lesson / control measure	Rating
Lb № 1, 2	(6…10)×2 = 12…20
Pr №1	(6…10)×1 = 6…10
Individual testing task 1	9…15
Control point 1	27…45
Lb № 3, 4, 5	(6…10)×3 = 18…30
Pr № 2	(6…10)×1 = 6…10
Individual testing task 2	9…15
Control point 2	33…55
Total for the semester	60…100

The combined exam is used as a form of final control for the discipline. With this type of control, the final grade Pp is calculated by the formula:

$$Pp = 0.6 \times Q_{sem} + 0.4 \times Q_{isp},$$

where Q_{sem} - grade for the semester in a 100-point system,

Q_{isp} - grade for the exam in a 100-point system.

The ticket for the exam consists of two theoretical questions and a task. Theoretical questions are evaluated at 30 points each, and the task - at 40 points (in total - 100 points).

Qualitative evaluation criteria in the national scale and ECTS

Satisfactory, D, E (60-74). Have a minimum of knowledge and skills. Work out and defend all laboratory works and IDs. Be able to provide a definition of the system, the definition of a linear stationary system. To know about the systems of equations of states of the system and the equations of input-output communication, to know about their physical meaning. Know about methods for solving system equations. Know about the transfer function of the system and its impulse response. Know the relationship between the system of equations of states of the system and its transfer function. Know the relationship between system transfer function and frequency response. Know about the structural diagrams of systems and the calculation of the final transfer function. Have an idea of the stability of the system and sustainability criteria. Have an idea of controllability and observability of the system.

Well, C (75-89). Know the main topics of the discipline. Work out and defend all laboratory works and IDs. Be able to provide a definition of the system, the definition of a linear stationary system. Know and be able to write systems of equations of state states and input-output communication equations, be able to explain their physical meaning. Know and be able to solve a system of system equations. Know and be able to construct an expression for the transfer function of the system and its impulse response. Know the relationship between the system of equations of states of the system and its transfer function. Know and apply the connection between the transfer function of the system and the frequency response. Be able to build structural diagrams of systems and calculate the final transfer function. Have an idea of the stability of the system and be

able to determine it, using the studied criteria of stability. Have an idea of controllability and observability of the system.

Excellent, A, B (90-100). Know all the topics of the discipline. Work out and defend all laboratory works and IDs. Be able to provide a definition of the system, the definition of a linear stationary system. Know and be able to write systems of equations of state states and equations of communication input-output and state-output, be able to explain their physical meaning. Know and be able to solve a system of system equations. Know and be able to construct an expression for the transfer function of the system and its impulse and transient response. Know the relationship between the system of equations of states of the system and its transfer function. Be able to apply this connection. Know and apply the connection between the transfer function of the system and the frequency response. Be able to build structural diagrams of systems and calculate the final transfer and frequency functions. Have an idea of the stability of the system and be able to determine it, using the studied criteria of stability. Have the concept of controllability and observability of the system, be able to calculate the degree of controllability and observability.

Criteria for assessing the knowledge and skills of the student in the combined exam.

Satisfactory, D, E (60-74). Show the required minimum of theoretical knowledge. Solve the problem.

Well, C (75-89). Firmly know the main topics of theoretical material. Solve the problem.

Excellent, A, B (90-100). Show complete knowledge of theoretical material. Solve the problem without error, 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>
</table>

Methodical support

Basic literature

1. L. Zade, Ch. Dezoer, Teoryia lyneinykh system. Pod red. H.S. Pospeloho. Perevod s anhl. [Tekst]. – M.: Nauka, 1970, 704 s.
2. Syhorskyi V.P. Matematycheskyi apparat ynzhenera. Yzdanye 2-e, stereotypnoe. [Tekst]. - Kyev: Tekhnika, 1977. - 768 s.
3. Sybert U.M. Tsepy, syhnaly, systemy. Tom 1. [Tekst]. – M.: Myr, 1988. – 336 s.

Supporting literature

1. Osnovy teorii system. Navchalnyi posibnyk z kursu «Zahalna teoriia system» Ukladach: k.t.n., s.n.s. Nikolov M.O. [Elektronnyi resurs]:. – Kyiv, 2014. – 188 s. Rezhym dostupu: www/URL:http://www.dut.edu.ua/uploads/l_918_64893570.pdf

2. Osnovy teorii system i systemnoho analizu: Navch. posibnyk /K.O. Soroka. [Elektronnyi resurs]:. – KhNAMH:, 2004. – 291 s. Rezhym dostupu: www/URL: http://eprints.kname.edu.ua/10895/1/%D0%A1%D0%B8%D1%81%D0%90%D0%BD%D0%B0%D0%BB%D0%B8%D0%B7_1_8%D0%BD.pdf
3. Teoriia system keruvannia: pidruchnyk / V.I. Korniienko, O.Iu. Husiev, O.V. Herasina, V.P. Shchokin; M-vo osvity i nauky Ukrainy, Nats. hirn. un-t. [Elektronnyi resurs]:. – Dnipro: NHU, 2017. – 497 s. Rezhym dostupu: www/URL: http://ir.nmu.org.ua/bitstream/handle/123456789/152814/CD1005.pdf?sequence=1&isAllowed=y

Information support

1. Mathematical software package MathCad 2000 Pro.
2. Electronics WorkBench 5.12 Pro design software package