Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Кафедра телекомунікацій

Applied aspects of systems analysis in telecommunications and radio engineering

Work program of the course (Syllabus)

Details of the course	
Higher Education Level	*Third (Educational and Scientific)*
Branch of knowledge	*17 Electronics and Telecommunications*
Speciality	*172 Telecommunications and Radio Engineering*
Educational and Research program	*Telecommunications and Radio Engineering*
Type of course	*Normative*
Mode of study	*daily study (full-time study)*
Year of study, semester	*2nd year, spring semester*
The scope of the course	*3 credits – 90 hours*
Semester control / control measures	*exam*
Course schedule	*2 hours a week*
Language	*Ukrainian*
Course Instructors	*Lecturer: Doctor of Technical Sciences, professor Lysenko Oleksandr Ivanovych, 096-225-28-20, Lysenko.a.i.1952@gmail.com* *Practical classes: Doctor of Technical Sciences, professor Lysenko Oleksandr Ivanovych, 096-225-28-20, Lysenko.a.i.1952@gmail.com*
Access to the course	*https://classroom.google.com/u/0/c/MTQ2NTkyNTA4NTA5, course code **zjvcpvr*** at the invitation of the teacher

Curriculum

1. Description of the course, its purpose, subject of study and learning outcomes

The course covers the main sections of the systems analysis theory (development of systems analysis as an applied scientific methodology, globalization of world processes in the development of systems research, systematics of human practice, systems analysis as a universal scientific methodology) and **decision theory** (problems of structuring decision-making, sequence and content of the decision-making main stages, methods of formal problem statement of decision-making, classification of models and tasks of decision-making) and provides modern approaches to the application of theoretical principles for solving practical problems in complex and large telecommunications and radio systems (networks).

The course is based on natural-scientific ideas about the existing universe.

The object of the course: methodology for applying a systems approach, systems analysis, construction and practical use of decision-making mathematical models in the analysis and synthesis of information and telecommunications and radio systems in general, and their individual hardware and research processes in telecommunications and radio engineering.

The course «Applied aspects of systems analysis in telecommunications and radio engineering» provides a sufficient level of fundamental applied scientific methodological preparation to write a PhD dissertation in the field of electronics and telecommunications majoring in telecommunications and radio engineering.

1.1. The purpose of the course

Acquisition of competencies (integral, general (GC1, GC3, GC5)), professional (SC1, SC2, SC3, SC4), knowledge (KN1, KN2, KN4) and skills (SK5 and SK12) on the basics of applycation a systems approach, systems analysis, construction and practical use of decision-making mathematical models in the analysis and synthesis of information and telecommunications and radio systems in general, and their individual hardware and research processes in telecommunications and radio engineering.

1.2. The main tasks of the course

According to the requirements of the educational and scientific program, applicants after mastering the course must demonstrate the following learning outcomes:

Program Competencies:

Integral competence

Competence to solve complex problems in the field of professional and/or research and innovation activities, which requires a profound reinterpretation of existing and creation of new core knowledge and/ or professional practice **due to mastering** terminology, definitions, basic concepts, symbolic notation of basic operations and their content used in the systems analysis theory and decision theory; experimental bases, physical and philosophical content of conditions of uncertainty, linguistic uncertainty and vagueness, their differences from stochastic and deterministic conditions; history of system approach development and the decision-making concept, problems of decision-making structuring, sequence and the maintenance of the decision-making basic stages, receptions of formal problem statement of decision-making, classification of models and tasks of decision-making.

General Competencies (GC)

GC 1 (Ability to critically analyze, evaluate and synthesize new complex ideas), **GC 3 (**Ability of critical thinking and solving the problems of scientific and research of innovation spheres; widening the limits and reinterpretation of available theoretical knowledge and professional practice**), GC 5 (**Ability to perceive, develop, use and adapt the basic research process with scientific completeness and consistency in a context that extends the limits of knowledge**) due to mastering:** the concept of binary relation; ways of transformation and actions over binary relations, properties and basic types of binary relations; relation aggregation procedures; the concept of factor-relation, ordered sets in decision-making, the structure of "dominance-indifference", the mechanism of choice; main types of measurement scales, invariant algorithms, measures of proximity on binary relations; concepts of empirical systems and measurement of benefits; general expert evaluation methods, expert evaluation of benefits methods, evaluation of expert competence methods; structuring the general goal methods and building a tree of goals, determining the set of optimal Pareto solutions.

Special professional competencies (SC)

SC 1 (Ability to adapt and summarize the results of modern research for solving scientific and practical problems**)**, **SC 2** (Ability to apply mathematical methods of scientific research, simulation modeling, applied aspects of systems analysis in various kinds of professional), **SC 3** (Ability to perform theoretical and experimental research, mathematical and computer modeling of processes in telecommunications and radio engineering systems and devices), **SC 4** (Ability to implement modern information technologies, equipment and methods of research, communications, and to increase energy and economic efficiency in the design, production and operation of telecommunication and radio engineering systems and devices) **due to mastering:** global criterion methods, translating criteria into constraints methods and consecutive concessions method, methods using binary relations, hierarchy analysis method (HAM), HAM algorithm taking into account special cases of HAM, methods of using HAM in conflict planning and resolution; the content of the decision-making problem in conditions of uncertainty, uncertainties classification, the concept of risk, models and methods of decision-making in conditions of uncertainty and risk management, decision-making criteria in conditions of uncertainty; decision tree method; the concept of utility in the economic justification of decisions in telecommunications, the concept of utility, types of utility, postulates of rational choice by economic criteria economic choice paradoxes , the conditions of utility function existence, utility function constructing methods; the concept of poorly structured problem and its uncertainty, fuzzy set and operations on it, fuzzy set display; the concept of fuzzy relation; decision-making methods by the fuzzy relation of preference; models and methods of decision-making by voting, consistent comparison by majority rule, interpretation of collective decisions by graph structures; the concept about psychological theories of behavior in decision-making, features of multifaceted decisions, formal and creative components in decision-making.

Program results of teaching

KNOWLEDGE (KN)

KN 1 (Conceptual and methodological knowledge in the field of research and / or professional activity and between the subject fields), **KN 2** (Knowledge of methods of scientific research in the field), **KN 4** (Modern mathematical methods of scientific research, simulation modeling, applied aspects of systems analysis), **which specifically consist in memorizing and understanding** the elements of decision theory (structure of tasks and types of decision-making models) in an amount sufficient to solve problems of improving the efficiency of modern and advanced telecommunications systems and networks and means of telecommunications; basic concepts and operations on binary relations, ways to transform and act on binary relations, properties and basic types of binary relations, representation of a preference system by binary relations; elements of the theory of expert evaluation and metric relations, the main scales for measuring preferences, proximity measures; basic decision-making methods provided by multicriteria (global criterion methods, methods for translating criteria into constraints and successive concessions, methods that use binary relations, rational decision-making principles in multicriteria problems); methods of solving multilevel hierarchical decision-making problems (rationale for the hierarchy analysis method (HAM), the matrix eigenvalues properties analysis of pairwise comparisons in HAM, examples of the HAM application in planning the telecommunications systems development and resolving conflicts in them); decision-making methods under conditions of uncertainty and fuzziness, physical and philosophical content of the decision-making problem under conditions of uncertainty and fuzziness, risk analysis of their identification, control and management; concepts of usefulness and rational choice, multifaceted decision-making models and methods, psycholinguistic aspects of decision-making.

SKILLS (SK)

SK 5 (Carry out independently the scientific and research work in the telecommunications and radio engineering fields using modern mathematical methods of scientific research, simulation modeling, and applied aspects of systems analysis), **SK 12** (Choose the appropriate (the best for certain criteria) method of solving the problem), **which consist in the specific skills and the applicant personal research in relation to** mathematical models construction of means of telecommunications and telecommunications systems, as well as technological processes occurring in them, n concepts of the systems analysis of decision theory, the structure and parameters identification of these models; the use of metric relations to process expert information and build the best multifaceted decision and binary relations to reflect the decision-maker structure of preferences; interpretation of decision-making results under conditions of uncertainty and fuzziness, analysis of their stability; computer simulation modeling of telecommunication and radio engineering means, telecommunication and radio engineering systems under conditions of uncertainty and fuzziness; performing mathematical formulation problems of optimization and improvement technical means of telecommunications and radio engineering, telecommunications and radio engineering systems in terms of decision theory; apply models and multifaceted decision-making methods; effective use in practice psychological aspects of systems analysis; decision-making taking into account the psycholinguistic features of obtaining the information necessary for decision-making.

2. Prerequisites and postrequisites of the course (place in the structural and logical scheme of education according to the relevant educational program)

To successfully master the course, the applicant must have knowledge of mathematical analysis, analytical geometry, matrix theory, differential equations, probability theory and mathematical statistics, mathematical research methods in telecommunications and radio engineering.

The courses «The scientific and innovative activities organization – 2», «Simulation modeling in telecommunications and radio engineering», «The effectiveness evaluation methods of telecommunications systems», «Models and calculation methods of telecommunication network», «Data analysis in IoT systems», «Big Data Processing Methods» are based on the results of studying this course, as well as academic courses for the universal competencies acquisition of the researcher (elective).

The systematic approach to the phenomena analysis and processes in the electronics and telecommunications field majoring in telecommunications and radio engineering is based on the outcome of studying this course, what allows to adequately mathematically describe these phenomena and processes and use mathematical models to synthesize effective telecommunications and radio systems (networks), devices and tools developed by applicants in their dissertations.

3. The content of the course

Title of sections and topics	Number of hours			
	Total	including		
		Lectures	Practices	IWS
Section 1. Applied aspects of decision theory in telecommunications and radio engineering				
Topic 1.1. General aspects of decision making	4	2	-	2
Topic 1.2. Binary relations, functions and choice mechanism. Metritised relation and expert evaluation	4	2	-	2
Topic 1.3. Decision-making in conditions of multicriteria	8	2	4	2
Topic 1.4. Decision making in conditions of uncertainty. The concept of usefulness and rational choice	6	2	2	2
Section 2. Applied aspects of systems analysis in telecommunications and radio engineering				
Topic 2.1. Subject area of systems analysis. Basic concepts of systems analysis. System analysis tasks formalization	6	2	2	2
Topic 2.2. Uncertainties disclosure in system analysis problems	6	2	2	2
Topic 2.3. System models and methods of multifaceted decision making. Systemic psycholinguistic aspects of decision making	6	2	2	2
Topic 2.4. Information analysis of system tasks. Structural and functional analysis of complex hierarchical systems	6	2	2	2
Topic 2.5. System analysis tasks and methods of multifactor risks. System management of complex telecommunication objects. System methodology for forecasting	6	2	2	2
Moduler test	8	-	2	6
Exam	30	-	-	30
Total hours	90	18	18	54

4. Learning materials and resources

Basic literature:

1. Катренко А.В., Пасічник В.В., Пасько В.П. Теорія прийняття рішень. Підручник. - К.: Видавнича група BHV, 2009.- 448 с.
2. Згуровський М. З., Панкратова Н. Д. Основи системного аналізу. Підручник. – К.: Видавнича група BHV, 2007.- 544 с.
3. Томашевський В.М. Моделювання систем. Підручник. – К.:Видавнича група BHV, 2007.- 352с.
4. Прикладні аспекти системного аналізу в телекомунікаціях та радіотехніці: Методичні рекомендації до виконання практичних занять [Електронний ресурс] : навч. посіб. для студ. спеціальності 172 «Телекомунікації та радіотехніка» / КПІ ім. Ігоря Сікорського; уклад.: С.О. Кравчук, О. І. Лисенко, В. С. Явіся, В. І. Новіков. – Електронні текстові дані (1 файл: 1,48 Мбайт). – Київ : КПІ ім. Ігоря Сікорського, 2021. – 46 с. https://ela.kpi.ua/handle/123456789/41977
5. Основи теорії цифрових систем автоматичного керування: LTI моделі для систем SISO та MIMO [Електронний ресурс]: навч. посіб. для студ. спеціальності 172 «Телекомунікації та радіотехніка» / КПІ ім. Ігоря Сікорського; уклад.: С.О. Кравчук, О. І. Лисенко, В. С. Явіся, В. І. Новіков. – Електронні текстові дані (1 файл: 4,32 Мбайт). – Київ : КПІ ім. Ігоря Сікорського, 2021. – 196 с. https://ela.kpi.ua/handle/123456789/41978
6. Ільченко М.Ю., Кравчук С.О. Телекомунікаційні системи. – Київ: Наукова думка, 2017. – 730 с. Досягнення в телекомунікаціях 2019 / за наук. ред. М.Ю.Ільченка, С.О.Кравчука: монографія. - Київ:

Інститут обдарованої дитини НАПН України, 2019.- 336 с. Рекомендовано до друку ВР КПІ ім.І.Сікорського (прот.№10 від 04.11.2019 р.) ISBN 978-617-7734-12-2

7. Лисенко О.І., Романченко І.С., Чумаченко С.М., Данилюк С.Л., Новіков В.І., Тачинінв О.М., Кірчу П.І., Валуйський С.В. Моделі застосування інформаційно-телекомунікаційних технологій на основі безпілотних авіаційних комплексів у надзвичайних ситуаціях. – К.: НАУ, 2016. – 332 с.

Additional literature:

8. Глоба Л.С. Розробка інформаційних ресурсів та систем. Підручник у 2 т.. – К.: НТУУ „КПІ”, 2014. Т.1. -376 с.
9. Глоба Л.С. Розробка інформаційних ресурсів та систем. Підручник у 2 т.. – К.: НТУУ „КПІ”, 2015. Т.2. -376 с.
10. Probability and Statistics. The Science of Uncertainty. Second Edition. Michael J. Evans and Je¤rey S. Rosenthal. University of Toronto. - *2009.-750 p.*
11. Probability and Stochastic. Processes with ApplicationsOliver Knill. Edition : 2009. Published by Narinder Kumar Lijhara for Overseas Press India Private Limited, 7/28, Ansari Road, Daryaganj, New Delhi-110002 and Printed in India. – 382 p.
12. Probability Theory: STAT310/MATH230. March 13, 2020. Amir Dembo. E-mail address: amir@math.stanford.edu. Department of Mathematics, Stanford University, Stanford, CA 94305. – 400 p.
13. **Information resources**
    Applied aspects of systems analysis in telecommunications and radio engineering. https://classroom.google.com/c/MTQ2NTkyNTA4NTA5. Access code: zjvcpvr.

Educational content

5. Methods of mastering the course (educational component)

Methods of mastering the course "Applied aspects of systems analysis in telecommunications and radio engineering" is to acquire practical skills in the use of information technology to solve specific technical problems arising in the development and operation of telecommunications equipment and information and telecommunications systems, acquisition of stable skills of acceptance of scientifically sound, conscious, confirmed by calculations decisions.

Full-time / distance learning

Lecture classes

№	The lecture title and a list of key issues (list of didactic means, literature references and tasks for IWS)
1	***General aspects of decision making.*** General aspects of decision making. History of the the concept of decision making development. Decision-making structuring problems. The sequence and content of the decision-making main stages. Methods of formal statement of the decision making problem. Classification of decision making models and tasks. *Recommended literature*: [1, 6-10, 14]
2	***Binary relations, functions and choice mechanism. Metritised relation and expert evaluation.*** The concept of binary relation. Transformation methods and action over binary relations. Properties and basic types of binary relations. Aggregation of relations. The concept of factor-relation. Orderly sets in decision making. Dominance-indifference" structures. The concept of choice mechanism. The main types of measurement scales. Invariant algorithms and averages value. Measures of proximity on binary relations. Empirical systems and measurement of benefits. General methods of expert evaluation. Expert evaluation of benefits methods. Evaluation of expert competence methods . *Recommended literature*: [1, 6-10, 14].
3	***Decision-making in conditions of multicriteria.*** Structuring the general goal methods and building a tree of goals. Determining the set of optimal Pareto solutions. Global criterion methods. Methods of translating criteria into constraints and consecutive concessions method. Methods using binary relations. Hierarchy analysis method (HAM). HAM algorithm. Special cases of HAM. Methods of using HAM in conflict planning and resolution. *Recommended literature*: [1, 6-10, 14].
4	***Decision making in conditions of uncertainty. The concept of usefulness and rational choice.*** The content of the decision-making problem in conditions of uncertainty. Uncertainties

	classification, the concept of risk, models and methods of decision-making in conditions of uncertainty and risk management, decision-making criteria in conditions of uncertainty; decision tree method.The concept of utility in the economic justification of decisions in telecommunications, types of utility, postulates of rational choice by economic criteria economic choice paradoxes, the conditions of utility function existence, utility function constructing methods. *Recommended literature*: [1, 6-10, 11-14].
5	***Subject area of systems analysis.*** Formation and development of systems analysis. Development stages of systems analysis as an applied scientific methodology. The role of world's processes globalization in the development of systems research. Systematic human practice. Systems analysis as a universal scientific methodology. Objects of system analysis. Properties and principles of system methodology. Classification of system analysis tasks and procedures. The concept of system problem complexity, spectral complexity, transcomputational complexity. Principles of overcoming transcomputational complexity of system tasks. Formalized problems characteristics of systems analysis. The problems levels characteristics that are solved during the systematic study of complex formalized systems. Methods and tools of systems analysis in the study of complex formalized problems. *Recommended literature*: [2, 3, 4, 5, 6-10, 14].
6	***Uncertainties disclosure in system analysis problems*.** Tasks and methods of disclosure the goals uncertainty. Situational uncertainty disclosure. Uncertainty disclosure in the tasks of interaction and conflict of strategies. Tasks and methods of disclosure systemic uncertainty. Functional dependence reproduction in the tasks of revealing conceptual uncertainty. Functional regularities reproduction examples - by discrete sampling. Systematic coordination of conflicting goals in the problem of finding rational compromises. Mathematical formulation of the problem. General strategy for solving problems of systemic interaction or systemic counteraction of coalitions. The strategy formalization of counteraction to coalitions. Problem solving methods of counteraction of coalitions. Problem solving examples of counteraction of coalitions. *Recommended literature*: [2, 3, 4, 5, 6-10, 14].
7	***System analysis and decision making under conditions of linguistic uncertainty and fuzziness.*** The concept of poorly structured problem and its uncertainty, fuzzy set and operation on it. Display of fuzzy set. Fuzzy relations. Fuzzy decision-making. Models and methods of decision-making by voting, consistent comparison by majority rule. Interpretation of collective decisions by graph structures. The concept of psychological theories of behavior in decision making. Features of multifaceted decisions. Formal and creative components in decision making. *Recommended literature*: [2, 3, 4, 5, 6-10, 14].
8	***Information analysis of system tasks.*** Analysis of quantitative and qualitative information characteristics. Formalization of characteristics and indicators of decision makers' (DM) awareness. Classification and situations recognition by integrated and partial indicators of DM awareness. Situations recognition under conditions of fuzzy information. Situations recognition under conditions of fuzzy information. Examples of recognizing critical and catastrophic situations in the event of a change in the DM awareness characteristics. Basic properties and features of complex hierarchical systems. Formalization of structural and functional analysis problems. General strategy for problems solving of structural and functional analysis. System optimization of complex structural elements of telecommunication systems. Problems solving examples of structural optimization in telecommunication systems. *Recommended literature*: [2, 3, 4, 5, 6-10, 14].
9	***System analysis tasks and methods of multifactor risks. System management of complex telecommunication objects.*** Development of methodology for ensuring the complex systems security. Properties and features of complex technical systems functioning in the conditions of multifactorial risks. Multi-hazard risks analysis of accidents and catastrophes. Security management basic principles and features of complex systems. Basic strategies of guaranteed security. Problems solving examples of system analysis of multi-hazard risks in telecommunication systems. Tasks analysis and classification of system management. System management tasks of efficiency and safety of complex objects, their structure and properties. Technical and economic analysis of complex objects systematic management. Fundamentals of digital automatic control in telecommunications and radio engineering. Fundamentals of the theory of digital automatic control systems: LTI models for SISO and MIMO systems. Relevance and purpose of prediction.

	Scenario analysis as a methodological basis for prediction. General procedure of expert evaluation in forecasting tasks. Scenario analysis information platform. Prediction technology in innovation in the field of telecommunications. Problem solving example of prediction for multi-criteria evaluation of innovative objects in the field of telecommunications. *Recommended literature*: [2, 3, 4, 5, 6-10, 14].
10	Exam

Practical classes

№	The lecture title and a list of key issues (list of didactic means, literature references and tasks for IWS)
1	**Methodology of structuring the general goal and building a goal tree and its application in the problems of telecommunications and radio engineering.** Determining the set of optimal Pareto solutions. Global criterion methods. Methods of translating criteria into constraints and consecutive concessions method. Methods using binary relations. Hierarchy analysis method (HAM). HAM algorithm. Special cases of HAM. Methods of using HAM in conflict planning and resolution. *Tasks for IWS:* [4-10, 14].
2	**Hierarchy analysis method and its application in the problems of telecommunications and radio engineering.** Rationale for the hierarchy analysis method. HAM algorithm. Special cases of HAM. Methods of using HAM in conflict planning and resolution.
3	**Models and methods of decision-making in conditions of uncertainty and its application in the problems of telecommunications and radio engineering.** Decision-making criteria in conditions of uncertainty; decision tree method.The concept of utility in the economic justification of decisions in telecommunications, types of utility, postulates of rational choice by economic criteria economic choice paradoxes, the conditions of utility function existence, utility function constructing methods. *Tasks for IWS:* [4-10, 14].
4	**Methods and tools of systems analysis in the study of complex formalized problems. in telecommunications and radio engineering.** Properties and principles of system methodology. Classification of system analysis tasks and procedures. The concept of system problem complexity, spectral complexity, transcomputational complexity. Principles of overcoming transcomputational complexity of system tasks.Formalized problems characteristics of systems analysis. The problems levels characteristics that are solved during the systematic study of complex formalized systems. *Tasks for IWS:* [4-10, 14].
5	**Methods of disclosure systemic uncertainty in the problems of telecommunications and radio engineering.** Functional dependence reproduction in the tasks of revealing conceptual uncertainty. Functional regularities reproduction examples - by discrete sampling. Systematic coordination of conflicting goals in the problem of finding rational compromises. Mathematical formulation of the problem. General strategy for solving problems of systemic interaction or systemic counteraction of coalitions. The strategy formalization of counteraction to coalitions. Problem solving methods of counteraction of coalitions. Problem solving examples of counteraction of coalitions. *Tasks for IWS:* [4-10, 14].
6	**Models and methods of decision making under conditions of linguistic uncertainty and fuzziness in the problems of telecommunications and radio engineering.** The concept of poorly structured problem and its uncertainty, fuzzy set and operation on it. Display of fuzzy set. Fuzzy relations. Fuzzy decision-making. Models and methods of decision-making by voting, consistent comparison by majority rule. Interpretation of collective decisions by graph structures. The concept of psychological theories of behavior in decision making. Features of multifaceted decisions. Formal and creative components in decision making. *Tasks for IWS:* [4-10, 14].
7	**Problems solving examples of structural optimization in telecommunication and radio engineering systems.** Analysis of quantitative and qualitative information characteristics. Formalization of characteristics and indicators of decision makers' (DM) awareness. Classification and situations recognition by integrated and partial indicators of DM awareness. Situations recognition under conditions of fuzzy information. Situations recognition under conditions of fuzzy information. Examples of recognizing critical and catastrophic situations in the event of a change in the DM awareness characteristics. Basic properties and features of complex hierarchical systems. Formalization of structural and functional analysis problems. General strategy for

	problems solving of structural and functional analysis. System optimization of complex structural elements of telecommunication systems. *Tasks for IWS:* [4-10, 14].
8	**System management of complex telecommunication and radio engineering objects.** Development of methodology for ensuring the complex systems security. Properties and features of complex technical systems functioning in the conditions of multifactorial risks. Multi-hazard risks analysis of accidents and catastrophes. Security management basic principles and features of complex systems. Basic strategies of guaranteed security. Problems solving examples of system analysis of multi-hazard risks in telecommunication systems. Tasks analysis and classification of system management. System management tasks of efficiency and safety of complex objects, their structure and properties. Technical and economic analysis of complex objects systematic management. Fundamentals of digital automatic control in telecommunications and radio engineering. Fundamentals of the theory of digital automatic control systems: LTI models for SISO and MIMO systems. Relevance and purpose of prediction. Scenario analysis as a methodological basis for prediction. General procedure of expert evaluation in forecasting tasks. Scenario analysis information platform. Prediction technology in innovation in the field of telecommunications. Problem solving example of prediction for multi-criteria evaluation of innovative objects in the field of telecommunications. *Tasks for IWS:* [4-10, 14].
9	**Module test.** *Tasks for IWS:* [4-10, 14].

6. Independent work of a postgraduate student

The applicant must repeat the material presented in the courses of mathematical analysis, linear algebra, probability theory and mathematical statistics to enhance the perception of mathematical and applied ideas of the course «Applied aspects of systems analysis in telecommunications and radio engineering».

More attention needs to be paid to solving problems in IWS to increase the speed and reliability of mastering the basic principles of the theory.

Recommended to conduct computer simulation experiments to test the theoretical positions presented in lectures for meaningful and lively perception of the course «Applied aspects of systems analysis in telecommunications and radio engineering», as well as use methods studied in the course when writing a dissertation in order to build mathematical models of the studied phenomena for further optimize the management of these phenomena.

Quality control of the student's mastery of the course is carried out by questioning in practical classes, checking the MT, as well as during the exam.

Policy and control

7. The policy of the course (educational component)

The material of the course «Applied aspects of systems analysis in telecommunications and radio engineering» is studied in the second year and in the second semester in lectures and practical classes. Theoretical material is presented and further used to solve exercises and problems on the basis of textbooks and manuals recommended by the Ministry of Education and Science of Ukraine for higher education applicants. Examples of application of mathematical programming (deterministic and stochastic, linear and nonlinear, static and dynamic), game theory, network planning, vector optimization, structural and functional analysis of complex hierarchical systems to solve practical problems in telecommunications and radio engineering are given in the textbook, recommended Methodological Council of KPI, and scientific and technical publications.

Quality control of the student's mastery of the course is carried out by questioning in practical classes, checking the MT, as well as during the exam. The assessment of the applicants success for the credit module is determined on the basis of the rating system.

Academic integrity

The policy and principles of academic integrity are defined in Section 3 of the Code of Honor of the National Technical University of Ukraine «Kyiv Polytechnic Institute named after Igor Sikorsky». Details: hhttps://kpi.ua/code

Norms of ethical behavior

Norms of ethical behavior of students and employees are defined in Section 2 of the Code of Honor ofthe National Technical University of Ukraine «Kyiv Polytechnic Institute named after Igor Sikorsky». Details: https://kpi.ua/code

8. Types of control and rating system for assessing learning outcomes (RSA)

1. The rating of the applicant from the credit module is calculated based on a 100-point scale, of which 60 points is the starting scale. The starting rating (during the semester) consists of points that the applicant receives for:

- performance of test (6 express tests);
- performance of module test (MT);

2. The assessment criteria.

2.1. Each express tests are evaluated at 5 points:

- «excellent» – complete answer (not less than 90% of the required information) – 5 points;
- «good» – fairly complete answer (not less than 75% of the required information) or complete answer with minor inaccuracies – 4 points;
- «satisfactory» – incomplete answer (not less than 60% of the required information) and minor mistakes – 3 points;
- «unsatisfactory» – the answer does not meet the requirements for «satisfactory» – 0 points.

2.2. The Module test is evaluated at 30 points:

- «excellent» – all tasks are done correctly and completely (not less than 90% of the required information) – 27-30 points;
- «good» – tasks are done partly (not less than 75% of the required information) – 22-26 points;
- «satisfactory» – tasks are done with errors (not less than 60% of the required information) – 18-21 points;
- «unsatisfactory» – tasks are not done or contained serious errors, MT is not credited – 0 points.

3. Calendar midterm attestation of applicants is carried out according to the value of the current rating at the time of attestation. If the value of this rating is not less than 50% of the maximum possible at the time of attestation, the applicant is considered attested. The condition for a positive first attestation is to obtain at least 8 points. The condition for a positive second attestation is to obtain at least 22 points.

4. The condition for admission to the exam is a starting rating of at least 30 points.

5. At the exam, applicants answer the questions from the examination paper. Each examination paper contains four questions (tasks). Each question (task) is evaluated in 10 points according to the following criteria:

- «excellent», complete answer, not less than 90% of the required information (complete, error-free solution of the task) – 9-10 points;
- «good», fairly complete answer, not less than 75% of the required information, there are minor inaccuracies (complete solution of the task with minor inaccuracies) – 7-8 points;
- «satisfactory», incomplete answer, not less than 60% of the required information, there are some mistakes (the task is performed with certain shortcomings) – 6 points;
- «unsatisfactory», the answer does not meet the requirements for «satisfactory» – 0 points.

6. The sum of starting points and points for the exam is converted into the examination grade according to the table:

Number of points	Assessment
100…95	Excellent
94…85	Very good
84…75	Good
74…65	Satisfactory
64…60	Sufficient
< 60	Unsatisfactory
calculation and graphic work was not credited or starting rating is less than 30 points	Not allowed

9. Additional information on the course (educational component)

- the provisions on the rating system of assesment are notified at the first lesson of the course;

- preliminary rating assessment R of the credit module (course) is brought to the applicants in the last lesson;
- calendar attestation of students is carried out by teachers according to the value of the current rating of the applicant at the time of attestation t. If the value of this rating is not less than **50%** of the maximum possible (R_t) at the time of attestation $RD_t \geq 0{,}5R$, the applicant is considered satisfactorily attested. Otherwise, the attestation statement is displayed «**not passed**».

Work program of the course (syllabus):

Compiled by: Doctor of Technical Sciences, professor Lysenko Oleksandr Ivanovych

Approved by the Department of Telecommunications (Protocol № 14 dated 27.05.2021 p.)

Agreed by the Methodological council of ITS (Protocol № 5 dated 09.06.2021 p.)