

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY
Faculty of Transport, Management and Logistics
Air Transportation Management Department

APPROVED

Vice-Rector for Academics

_____ A. Gudmanian

«__» _____ 2019.



Quality Management System

COURSE TRAINING PROGRAM

on

«Systems Analysis»

Field of Study: 27 «Transport»

Major: 275 «Transport Technologies (by air transport)»

Specialty: 275.4 «Transport Technologies (by air transport)»

Educational Professional Programs: «Organization of the Transportation and Management (by air transport)»

«Organization of the Aviation Operations and Services»

«Automation and Automatization of the Aviation Operations and Services»

«Multimodal Transport and Logistics»

«Transport Systems (by air transport)»

Year of Study – 2 Semester – 3

Lectures – 34

Examination – Semester 3

Practicals – 34

Self-Study – 82

Total (hours/ECTS credits) – 150/5,0

Course paper – 3 semester

Index: ECB-7-275/17-2.1.9



The Course Training Program on «Systems Analysis» is based on the Educational program and Bachelor Extended Curriculum №ECB-7-275/17 for Specialty 275.4 «Transport Technologies (by air transport)», Educational Professional Programs «Organization of the Transportation and Management (by air transport)», «Organization of the Aviation Operations and Services», «Automation and Automatization of the Aviation Operations and Services», «Multimodal Transport and Logistics», «Transport Systems (air transport)», Ukrainian version of the Course Training Program on «Fundamentals of the Transport System Process Theory» approved by Vice-Rector for Academics _____, and corresponding normative documents (order №207/ОД of 27.04.18).

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INTRODUCTION

The Course Training Program of the discipline «Systems Analysis» developed based on the «Methodological guidelines for development and performance of the Course Training Program», approved by the order №106/поз, of 13.07.2017 and corresponding normative documents.

1. EXPLANATORY NOTE

1.1. Planned Results

Subject «Systems Analysis» completes educational process of special disciplines systems theoretical and practical training specialist for Major 275 «Transport Technologies (by air transport)», Specialty 275.04 «Transport Technologies (by air transport)» and Educational Professional Programs «Organization of the Transportation and Management (by air transport)», «Organization of the Aviation Operations and Services», «Automation and Automatization of the Aviation Operations and Services», «Multimodal Transport and Logistics», «Transport Systems (air transport)».

The aim of the subject teaching is to form specialists given the ability and skills profile of the practical use of general systems theory and systems analysis in the design and organization of the planning and management of transport companies, transport systems. In a market economy the competitiveness and viability of the enterprise in a large extent depends on the rational use of the mechanisms and methods of manufacturing processes. System analysis and general systems theory is a necessary theoretical basis, which is to form a student's future specialist organization management.

The tasks of studying the subject are:

- defining the basic concepts of and approaches to systems analysis;
- understanding of the systems research methods and their practical use;
- understanding of the general concepts of economic processes modelling.

As the result of studying the discipline «Systems Analysis» the students must obtain the following **competences**:

- ability to analyze technical, economic, technological, legal, social, and environmental components of the organization of air transportation in terms of knowledge of fundamental disciplines, as well as on the basis of appropriate economic and mathematical methods;
- ability to identify, define, formulate, select and apply appropriate analytical methods and modelling techniques to solve engineering problems in the field of transport and logistics;
- ability to use appropriate software (programming languages, packages) for conducting research on transport and logistics.

Interdisciplinary links

The academic discipline «Systems analysis» is complemented by such disciplines as «Probability Theory and Mathematical Statistics», «Higher Mathematics», being the basis for learning such disciplines as «Air Cargo Transportation», «Air Passenger Transportation».

1.2. Course Training Program

The educational material of the discipline is structured modularly and consists of 2 educational modules, namely:

Module №1. «Systems theory and systems analysis for management tasks».

Theme 1. The history of systems theory and systems analysis.

The place and role of systemic ideas in practice. The history of systematic research. The concept of «systems analysis», «systems theory». The development of system concepts today. The role and place of systematic methodology in knowledge of nature and society. The concept of «systematic methodology». Scheme scientific fields associated with general systems theory.

Theme 2. Basic concepts of systems theory.



The main definitions of the term «system» and examples of the system. The conditions of the system. Subsystem. Supersystem. Element of the system. The properties of the element. External and internal communications. Direct and feedback. The concept of structure and hierarchy. The main factor is systematizing its function. Inputs of the system. The outputs of the system. Purpose-oriented systems. System status. The behaviour of the system. Balance. The stability of the system. The properties of the system. The concept of an integrated whole. Emergence. Synergic. Hierarchic of the system. Interdependence between system and environment. The level of independence and transparency of the system. Reliability of the system. The dimension of the system.

Theme 3. Structure of the system and systems classification

Definition of the term “structure”, various types of structure. Types of a structure: linear, hierarchical, network, matrix, crystalline. The main signs of a system.

Basic principles of systems classification. Systems objects and systems processes. Classification of systems: based on a system’s relation to environment, based on the origin of a system (elements, connections, subsystems), based on the description of the system’s variables, based on laws description that refers to functioning of a system, in accordance with the type of a system control (in the system itself). Dynamic and static systems. The concept of a complex system. Deterministic and stochastic systems. Real and abstract systems. Classification of logistics systems. Classification of information systems.

Theme 4. Basic properties of complex systems

System complexity. The main features of the system. The main types of complexities, the basic concepts of a complex system. Invariant properties of the system. Determining the complexity of the structure with entropy. The degree of complexity of the system. Approaches to the determination of complexity of systems. Size and complexity of the system. Examples of complex systems in aviation.

Theme 5. Information and system.

Concept information. Types of information: incoming, outgoing, internal. Classification of information by feature. Basic information properties. Modes of updating information: consecutive, parallel. Abstraction. Synthesis analysis, induction and deduction, heuristics. Modeling. Updating. Layout Idealization. Formalization. Number of information in the system. The main relationship between entropy and information.

Module №2. «Systems modelling».

Theme 1. System analysis methods.

Classification of methods of system analysis. Classification of systems simulation methods. Imitation methods, the Monte Carlo method. Fuzzy sets.

Theme 2. Basic concepts and definition of modelling, and operations on models

Definition of the term «model». Models and modelling. The objectives of modelling. Applied aspects of modelling. The main properties of the model and modelling. Homomorphism. Isomorphism. Mathematical and computer modelling.

Linearization. Identification. Aggregation and decomposition. Expert estimation and numerical experiment.

Theme 3. Models and systems modelling

General scheme of constructing a model. Interactions of subject, object, purpose and resources of modelling. Definitions of the terms «effect», «efficiency». Praxeology and effectiveness. Criteria of effectiveness.

Mathematical and computational systems modelling. Formulation and research of a model. Factor of uncertainty. Multicriteria optimization.

Theme 4. System management

Management as an element of the functioning of organized systems of various nature: biological, technical and socio-economic systems. Management in the system, system



management. The essence of the Beer's principle. Examples of simulation applications for solving system management tasks.

A separate third module is the course paper that a student performs in the third semester. Course paper is an important stage in preparing a future specialist in transport technology.

2. SUBJECT CONTENT

2.1. Subject Structure

№	Theme	Academic hours			
		Total	Lectures	Practicals	Self-Study
1	2	3	4	5	6
Semester 3					
Module №1 «Systems theory and systems analysis for management tasks»					
1.1	The history of systems theory and systems analysis	13	4	4	5
1.2	Basic concepts of systems theory	13	4	4	5
1.3	Structure of the system and systems classification	13	4	4	5
1.4	Basic properties of complex systems	11	4	2	5
1.5	Information and system	8	2	2	4
1.6	Module Test №1	6	-	2	4
Total by Module №1		64	18	18	28
Module №2 «Systems modelling»					
2.1	System analysis methods	13	4	4	5
2.2	Basic concepts and definition of modelling, and operations on models	13	4	4	5
2.3	Models and systems modelling	13	4	4	5
2.4	System management	11	4	2	5
2.5	Module Test №2	6	-	2	4
Total by Module №2		56	16	16	24
Module №3 «Course paper»					
3.1	Implementation and defense of course paper	30	-	-	30
Total by Module №3		30	-	-	30
Total by the 3 semester		150	34	34	82
Total by the discipline		150	34	34	82



2.2. Lectures, their Subject Matter and Planned Hours

№	Theme	Academic hours	
		Lectures	Self-Study
3 semester			
Module №1 «Systems theory and systems analysis for management tasks»			
1.1	The history of systems theory and systems analysis	2	1
1.2	Basic concepts of system theory. System Properties	2	1
1.3	Structure of the system	2	1
1.4	Systems classification	2	1
1.5	Hierarchical approach to system classification	2	1
1.6	Basic properties of complex systems	2	1
1.7	Information and system	2	1
1.8	Patterns of occurrence and formulation of system goals	2	2
1.9	Basic factors, stages and procedures of system analysis	2	2
Total by Module №1		18	11
Module №2 «Systems modelling»			
2.1	System analysis methods	2	1
2.2	Basic concepts and definition of modelling	2	1
2.3	Classification of models	2	1
2.4	Basic operations on models	2	1
2.5	Stages of modelling and evaluation of system efficiency	2	1
2.6	Construction and research of models. Model Properties	2	1
2.7	Requirements for selecting a criterion. Multi-Criterion Optimization: Pareto-Set and Other Methods.	2	1
2.8	System management. The process of controlling systems.	2	2
Total by Module №2		16	9
Total by the discipline		34	20

2.3. Practicals, their Subject and Planned Hours

№	Theme	Academic hours	
		Practicals	Self-Study
Semester 3			
Module №1 «Systems theory and systems analysis for management tasks»			
1.1	The history of systems theory and systems analysis	2	1
1.2	Basic concepts of system theory. System Properties	2	2
1.3	Structure of the system	2	1
1.4	Systems classification	2	2
1.5	Hierarchical approach to system classification	2	1
1.6	Basic properties of complex systems	2	2
1.7	Information and system	2	2
1.8	Basic factors, stages and procedures of system analysis	2	2
1.9	Module Test №1	2	4
Total by Module №1		18	17
Module №2 «Systems modelling»			
2.1	System analysis methods	2	1
2.2	Basic concepts and definition of modelling	2	2



2.3	Classification of models	2	1
2.4	Basic operations on models	2	2
2.5	The task of resource allocation. General staging	2	1
2.6	Solving tasks for constructing models	2	2
2.7	Management in the system	2	2
2.8	Module Test №2	2	4
Total by Module №2		16	15
Total by the discipline		34	32

2.4. Self-Study, its Content and Planned Hours

№	Subject of the Student Self-study	Academic hours
Semester 3		
1.	Studying of the lecture material	20
2.	Preparation for practical sessions	24
3.	Preparation for the module tests №1, №2	8
4.	Course paper	30
Total by the discipline		82

2.4.1. Course paper

A Course paper (CP) in the discipline is done in the 3th semester according to the approved in due order methodological recommendations with the aim to improve and widen theoretical knowledge and skills gained by a student during studying systems theory and systems analysis.

Course paper is an important stage in the training of a specialist in air transportation management. The goal of the Course paper is to research and analyze the transportation system of the country as a complex system.

To make the Course paper successfully a student must **know** basic concepts of systems theory, basic properties of a system, methods of a systems analysis, general system management theory, **to be able to** research real enterprises systems with the use of systems analysis methodology.

A student should prepare, design and defend CP individually according to methodical recommendations. The Course paper must include original empirical investigations of student.

Duration of the Course paper preparation equals to 36 hours of self-work.

3. BASIC CONCEPTS OF GUIDANCE ON THE SUBJECT

3.1. Teaching Techniques

The process of training embraces the following teaching techniques: lecture-visualization, elements of problem lecture, elements of dialogue with the audience (lectures-interviews), brainstorming, seminar-discussion in the framework of practical classes, business games, presentations. All these methods are applied in order to contribute to a student's educational and cognitive activity in the course of learning.

3.2. Recommended Literature

Basic Literature

3.2.1. Systems Analysis and Design: An Object-Oriented Approach with UML, 5th Edition by Dennis, Wixom, and Tegarden John Wiley & Sons. – 544 p.

3.2.2. Шарапов О. Д., Дербенцев В. Д., Семьонов Д. С. Системний аналіз: Навч.-метод. посібник для самост. вивч. дисц. – К.: КНЕУ, 2003. – 154 с.

3.2.3. Юн Г.М., Марінцева К.В. Основи теорії систем і системний аналіз. Конспект



лекцій. – К.: НАУ, 2004. – 68 с.

Additional references

3.2.4. Системний аналіз: навч. посібник / О.І. Аршинова, А.В. Шевченко. – К.: НАУ, 2008. – 128 с.

3.2.5. Катренко А.В. Системний аналіз об'єктів та процесів комп'ютеризації: Навч. посібник. – Львів.: «Новий світ» - 2000», 2003. – 424 с.

3.2.6. Матвеев Ю.Н. Основы теории систем и системного анализа: учебное пособие / Ю.Н. Матвеев. Ч. 1. 1-е изд. Тверь: ТГТУ, 2007. – 100 с.

3.2.7. Системний аналіз складних систем управління: Навч. посіб. / А. П. Ладанюк, Я. В. Смітюх, Л. О. Власенко та ін. – К.: НУХТ, 2013. – 274 с.

3.3. Internet Information Resources

3.2.8. <http://www.lib.nau.edu.ua/Details.aspx?id=70484&lang=uk-UA>.

3.2.9. http://eprints.kname.edu.ua/10895/1/СисАналіз_1_8.pdf

3.2.10. <http://er.nau.edu.ua/handle/NAU/34231>

4. RATING SYSTEM OF KNOWLEDGE AND SKILLS ASSESMENT

4.1. The assessment of different kinds of academic work done by the student and obtained knowledge and skills performed in points according to the table. 4.1.

Table 4.1

Semester 3				
Module №1		Module №2		Max Score
Academic Activities	Max points	Academic Activities	Max points	
Performing tasks during practical's 1.1-1.8	24 (Total)	Performing tasks during practical's №2.1-2.7	21 (Total)	
Performing test tasks	10 (Total)	Performing test tasks	13 (Total)	
<i>For admission to the implementation of modular control №1 student must score at least 21 points</i>		<i>For admission to the implementation of modular control №2 student must score at least 21 points.</i>		
Module Test №1	10	Module Test №2	10	
Total by module №1	44	Total by module №2	44	
Semester examination test				12
Total by the 3 semester				100

Semester 3	
Module №3	Max Score
Academic Activities	
Implementation of Course paper	60
Defense of Course paper	40
Implementation and defense of Course paper	100

4.2. Performing of the certain kinds of academic works should be credited to the student in case if he received a positive rating (table 4.2).



Table 4.2

Correspondence between Rating Scores and National Scale Ratings

Grade, points					National Scale Rating
Performing tasks during practical's		Performing the test tasks		Module Tests	
№1.1-1.8	№2.1-2.7				
22-24	19-21	9-10	12-13	9-10	Excellent
18-21	16-18	8	10-11	8	Good
15-17	13-15	6-7	8-9	6-7	Satisfactory
less then 15	less then 13	less then 6	less then 8	less then 6	Bad

4.3. The sum of the grades, obtained by the student for certain kinds of academic works, is current and module test ratings, and transfers to the module tests control records.

4.4. The sum of the current and module grades ratings is total module grade (table 4.3), in points and by the national scale and transfers to the module tests control records.

Table 4.3

Correspondence between the Total Module Rating Scores and National Scale Ratings

Module №1	Module №2	National Scale Rating
40-44	40-44	Excellent
33-39	33-39	Good
27-32	27-32	Satisfactory
less then 27	less then 27	Bad

4.5. The total module grade received by the student on the results of the implementation and defence of course paper in the national scale and ECTS is to be entered to the examination records.

4.6. The sum of the total module grades is total semester module grades, and should be calculated in national scale (table 4.4).

Table 4.4

Correspondence between the Total Semester Module Rating Scores and National Scale Ratings

Rating Score	National Scale Rating
79-88	Excellent
66-78	Good
53-65	Satisfactory
less then 53	Bad

Table 4.5

Correspondence between the Examination Rating Score and National Scale Rating

Rating Score	National Scale Rating
11-12	Excellent
9-10	Good
7-8	Satisfactory
less then 7	Bad

4.7. The sum of the total semester module test and examination grade is total semester grade, and should be calculated in national scale and ECTS (table 4.6).



Table 4.6

Correspondence between the Total Semester Rating Score, National Scale Rating and ECTS Scale

Score	National Scale Rating	ECTS Scale Rating	
		Rating	Comments
90-100	Excellent	A	Excellent (excellent performance with few minor mistakes)
82-89	Good	B	Very Good (performance above the average with a number of mistakes)
75-81		C	Good (good performance on the whole, with a number of gross mistakes)
67-74	Satisfactory	D	Satisfactory (not bad, with a considerable number of mistakes)
60-66		E	Sufficient (performance meets the minimal criteria)
35-59	Bad	FX	Bad (bad performance; a second testing is required)
1-34		F	Bad (very bad performance; a student shall redo the course)

4.8. The total semester module grade in the national scale and ECTS is to be entered to the examination records, students card and students record book.

4.9. The total semester module grade is to be entered to the students card and students record book, i.e: **92/EX./A, 87/Good/B, 79/Good/C, 68/Sat./D, 65/Sat./E** etc.

4.10. The total module grade received by the student on the results of the implementation and defence of course paper, in addition to the examination records, is also entered to the students card, students record book and Diploma Annex, i.e: **92/EX./A, 87/Good/B, 79/Good/C, 68/Sat./D, 65/Sat./E** etc.

4.11. The total grade for the discipline, which is taught during one semester, is equal to the total semester module grade.

The above-mentioned total grade for the discipline is to be entered to the Diploma Annex.



(Ф 03.02 – 01)

АРКУШ ПОШИРЕННЯ ДОКУМЕНТА

№ прим.	Куди передано (підрозділ)	Дата видачі	П.І.Б. отримувача	Підпис отримувача	Примітки

(Ф 03.02 – 02)

АРКУШ ОЗНАЙОМЛЕННЯ З ДОКУМЕНТОМ

№ пор.	Прізвище ім'я по-батькові	Підпис ознайомленої особи	Дата ознайомлення	Примітки

(Ф 03.02 – 04)

АРКУШ РЕЄСТРАЦІЇ РЕВІЗІЇ

№ пор.	Прізвище ім'я по-батькові	Дата ревізії	Підпис	Висновок щодо адекватності

(Ф 03.02 – 03)

АРКУШ ОБЛІКУ ЗМІН

№ зміни	№ листа (сторінки)				Підпис особи, яка внесла зміну	Дата внесення зміни	Дата введення зміни
	Зміненого	Заміненого	Нового	Анульованого			

(Ф 03.02 – 32)

УЗГОДЖЕННЯ ЗМІН

	Підпис	Ініціали, прізвище	Посада	Дата
Розробник				
Узгоджено				
Узгоджено				
Узгоджено				