Ministry of Education and Science of Ukraine
State Higher Educational Institution
«National Mining University»

Department of System Analysis and Management

Zheldak T.A.

WORKING PROGRAM OF EDUCATIONAL DISCIPLINE
"Methodology of scientific research"
For masters of specialty 124 "System Analysis"

Dnepr
NMU
2017

Zheldak T.A. Program of the discipline "Methodology of scientific research" for masters of specialty 124 "System analysis" / T.A.Zheldak; National min.un-ty, Dep. system analysis and management. - D.: NMU, 2017. - 12 p.

Considered and approved by the methodical commission on the specialty 124 "System Analysis" on the submission of the Department of System Analysis and Management

Contents

INTRODUCTION

The program training results of the master's degree in system analysis are defined in the Standard of Higher Education by specialty 124 "System Analysis".

In the educational and professional program of masters training in this specialty of the State University "NMU" [2.1] the distribution of programmatic learning outcomes was carried out according to the organizational forms of the educational process. The discipline "Methodology of scientific research" includes the following professional competencies:

FK4 Ability to form new hypotheses and research tasks in the field of system analysis and decision-making, to choose the appropriate directions for their application.

FK5 Ability to formulate, analyze and synthesize when solving scientific problems at an abstract level.

FK6 Ability to design the architecture of intelligent information systems.

FK10 Ability to apply modern information technology in solving problems of system analysis.

During the study of the discipline, the Master must master the following general and professional learning outcomes:

ZRN 5 Exercise curiosity, risk aversion, ability to think, inspire new ideas, incarnate them, ignite them, combine and experiment

ZRN 6 To select and prepare information and tasks for the project team, set goals and formulate tasks for the implementation of projects and programs

PRN 2 To know the methods of disclosure of uncertainties in the tasks of system analysis, to be able to reveal situation uncertainties, and uncertainties in the problems of interaction, counteraction and conflict of strategies, to find a compromise when disclosing conceptual uncertainty, etc.

PRN 6 Know and be able to apply evolutionary modeling and genetic optimization methods, inductive modeling techniques, and mathematical apparatus for fuzzy logic, neural networks, game theory and distributed artificial intelligence, etc.

PRN 7 Ability to develop expert and advisory systems in conditions of poorly structured data of different nature.

PRN 8 Know and be able to implement highly loaded computing and data processing systems in system analysis and management tasks, and decision support systems.

The purpose of the discipline "Methodology of scientific research" - to form the skills of masters in the use of modern experimental methods for finding knowledge, their algorithmic processing in the implementation of large software complexes, application in the work of system analytics and use in solving typical tasks of activity.

Realization of the goal requires the transformation of the program results of training in discipline, and the selection of the content of the discipline according to this criterion.

Requirements for the structure of the work program of disciplines are given in [2.5].

1. FIELD OF USE

The work program is developed for

• implementation of a competent approach in shaping the structure and content of discipline;

• internal and external quality control of training specialists;

• accreditation of the educational program in the specialty.

The work program sets:

• scope and terms of teaching discipline;

• designation of physical quantities;

• disciplinary learning outcomes and their level of difficulty;

• thematic plan and volume distribution according to the organizational forms of the educational process;

• requirements for the structure and content of individual tasks;

• tasks for independent work of the applicant;

• generalized diagnostic tools, criteria and procedures for assessing the achievements of applicants;

• composition of the complex of teaching and methodological provision of discipline.

2. NORMATIVE REFERENCES

The work program of the discipline is developed on the basis of the following normative documents:

2.1 Educational program of masters training by specialty 124 "System analysis" / Ministry of Education and Science of Ukraine, NTU "Dniprovska Polytechnic". - D.: NTU "DP", 2018 - 31 p.

2.2 Licensing conditions for the educational activities of educational institutions. Approved by the Decree of the Cabinet of Ministers of Ukraine dated December 30, 2015, №. 1187. http://zakon5.rada.gov.ua/laws/show/1187-2015-p/page.

2.3 Project of the Higher Education Standard for Masters of Specialty 124 "System Analysis".

2.4 Law of Ukraine "On Higher Education".
http://zakon5.rada.gov.ua/laws/show/1556-18.

2.5 Standard of Higher Education of the State Higher Educational Institution "NMU" Design of the educational process. Dnipropetrovsk: NMU, 2016. - 74 p.

3. SCOPE AND TERMS OF TEACHING DISCIPLINE

Total amount - 6 ECTS credits (180 academic hours).

It is taught at the 1st year, in the 2nd semester, in the 3rd quarter (8 weeks).

4. MARKING OF PHYSICAL QUANTITIES

Commonly used notation is used

5. EXPECTED DISCIPLINARY LEARNING OUTCOMES

The code and the content of educational outcomes for an educational-professional program	Code and content of disciplinary learning outcomes (DRN)
1	2
PRN 2 Know the methods of uncovering uncertainties in system analysis tasks, be able to reveal situational uncertainties, and uncertainties in the tasks of interaction, counteraction and conflict of strategies, find a compromise when disclosing conceptual uncertainty, etc.	DRN2-1 Definition of a scientific experiment, its significance for research
	DRN2-2 Examples of the use of system analysis at its first stage - the stage of the task of scientific research in various fields of knowledge, on which the choice of object and subject of research is carried out, the definition of goals and criteria for evaluating the achieved results and specification of the research tasks
PRN 6 Know and be able to apply methods of experimental research, mathematical analysis of data, etc.	DRN6-1 Build an experiment plan.
	DRN6-2 Be able to prepare for the experiment
	DRN6-3 Use different methods to verify the results of the experiment
	DRN6-4 Realize the results of experimental research using modern simulation and mathematical simulation packages.
	DRN6-5 Realize with modern planning and choice of research direction
	DRN6-6 Realize with the help of modern mathematical packages the method of group consideration of arguments with different optimality criteria
PRN 7 Be able to develop scientific publications and submit them to the press.	DRN7-1 Realization with the help of modern mathematical packages methods of clustering of objects of experimental investigation in multidimensional space
	DRN7-2 Apply the results of the experiment to solve optimization problems

PRN 8 Know and be able to implement high-load computing and data processing systems in system analysis and management tasks.	DRN8-1 Perform preliminary processing of information, recover lost and incomplete information.
	DRN8-2 Perform a data classification using typical and heuristic methods.

6. THEMATIC PLAN AND DISTRIBUTION OF DISCIPLINE BY TYPES OF TRAINING

Code DRN	Kind and theme of training sessions	Volume, *hours*		
		aud	CPC	total
1	2	3	4	5
	Lectures	**28**	**68**	**90**
DRN2-1	1. Introduction. Tasks of the research	2	8	10
DRN6-1 DRN6-4	2. The concept of the experiment.	4	12	16
DRN6-2	3. Experiment Planning Methods	2	6	8
DRN6-6	4. Preparing for an experiment	4	12	16
DRN6-6 DRN6-3	5. The method of group account of arguments: the balance of variables, forecasting, extrapolation	2	8	10
DRN7-2	6. Methods of data processing	4	12	16
DRN8-1	7.	2	6	8
DRN8-2	8. Classification: classical methods and algorithms	2	6	8
DRN8-2 DRN7-1	9.Classification: pyramidal networks, typical algorithms	2	8	10
DRN8-1	10. Restoration of fuzzy information	4	12	16
	Laboratory work	**28**	**68**	**90**
DRN2-2	1. Applying the rules for building an experiment plan.	4	13	17
DRN6-4 DRN6-2	2. Data generation for experiment	4	13	17
DRN8-1 DRN6-6	3. Processing of experimental data by typical methods	4	13	17
DRN7-2 DRN6-5	4. The use of statistical algorithms to determine the characteristics of the object of research	6	19	25
DRN7-1	5. Classification of results in multidimensional space	4	13	17
DRN8-2 DRN7-2	6. Recover lost information in the knowledge base	6	19	25
	Control of the laboratory module	2	-	2
	In all	**56**	**90**	**180**
	Lectures (classroom - 4 hours per week)	**28**	**68**	**90**

Code DRN	Kind and theme of training sessions	Volume, *hours*		
		aud	CPC	total
1	2	3	4	5
	Laboratory classes (classroom - 4 hours per week)	**28**	**68**	**90**
	Final (semester) control - differential grade: II semester, 3 quarter			

7. REQUIREMENTS FOR INDIVIDUAL TASKS

In the study of the discipline the individual task is not provided.

8. TASKS FOR INDEPENDENT WORK OF THE STUDENT

The main tasks for independent work include:

- preliminary processing of information provision for each topic;
- preparation for ongoing control - solving tasks of self-control on each topic;
- preparation for the final (semester) control.

9. FORM OF FINAL CONTROL, DIAGNOSTIC TOOLS, CRITERIA AND EVALUTION PROCEDURES

9.1 Form of final control

The form of final control is a differentiated credit.

An assessment of the level of the formation of disciplinary competencies in the form of a differentiated score can be made without the participation of a student based on the results of current control.

9.2 Forms of current control

Determination of the level of the formation of disciplinary learning outcomes during the current control is carried out for:

- testing achievements for a specific section of the work program of discipline;
- laboratory work (inspection and protection);

9.3 Diagnostic tools

9.3.1 Generalized diagnostic tools

Diagnostic tools are presented in the form of theoretical questions and concretized tasks with numerical input data and are designed to assess the student's ability:

- differentiate, integrate and unify knowledge;
- apply rules, methods, principles, laws in specific situations;
- interpret circuits, graphs, diagrams;

- analyze and evaluate the facts, events and predict the expected results from the decisions taken;

- Teach material on paper logically, consistently, in accordance with the requirements of current standards.

9.3.2 Specified diagnostic tools

The precise diagnostic tools that are directly used for control measures during lectures are formed on the basis of generalized numerical or other concretization of generalized means in the form of closed and open type tests.

9.4 EVALUTION CRITERIA AND PROCEDURES

9.4.1 Lecture material

The evaluation of the results of the accomplished tasks is carried out by comparing them with the standards - samples of correct and complete answers by identifying the level of competence generation based on the analysis of the student's response using the coefficient of assimilation as a percentage that adapts the value of the assessment to the ECTS scale:

$$P_i = a / m \ (\%),$$

where a is the number of correct answers or the essential operations performed by the decision benchmarks; m is the total number of questions or significant transactions in the decision benchmark.

The results of the students' achievements (as a percentage) obtained from the described scheme are presented in the estimations of the ECTS and the national scale:

Marks, %	Grade
National Differentiated Scale	
90-100	Excellent
74-89	Good
60–73	Satisfactory
1-59	Fail
Scale of ECTS	
90-100	A
82-89	B
74-81	C
64–73	D
60–63	E
35-59	Fx
1-34	F

If the level of student achievement below 60% is fixed or if the student does not appear on a control event, then he is rated "Fx" and "unsatisfactory". In such cases, the student is obliged to further master this topic of classes and undergo a re-evaluation of his learning outcomes.

9.4.2 Laboratory work

Each laboratory work is evaluated by the quality of the report by means of the coefficient of assimilation or by the expert method, when the maximum assessment is made subject to the following conditions:

- compliance with the report on the implementation of laboratory work methodological recommendations;
- correctness of execution
- possession of theoretical knowledge on which the subject of research is based;
- possession of experimental research methods;
- general and professional literacy, conciseness and logical sequence of presentation of the material;
- compliance of the report with the current standards;
- availability of references to sources of information;
- independence of execution (it turns out during protection).

The level of achievements based on the results of a complex of laboratory work by discipline is defined as the average value of the results of the current control of each.

During the examination, the evaluation for laboratory work is determined by the percentage of the correct steps of the algorithm for its implementation.

Integral evaluation of achievements in all laboratory work is accepted (student achievement level is not less than 60% or at least 60 points) only in the case when all laboratory work provided by the program of the discipline is fulfilled and evaluated.

9.4.3 Integral level of student achievement in discipline

The integral level of student achievement in the mastering of discipline material as a whole is calculated as the weighted mean of the level of formation of competences in lecture, practical and laboratory classes:

$$IP = \sum_{i=1}^{n} \frac{(P_i \times T_i)}{T}, \%,$$

where n *is a* number of types of training sessions;

P_i is the level of achievements for the i-th type of occupation, %;

T_i is a volume of the i-th type of occupation;

T is a total volume of discipline.

Achievements of a student in mastering a certain discipline in general can not be evaluated positively if from any planned control measure in this discipline the student has not received a positive assessment.

If the level according to the results of any current control measure is higher than 60%, then the national scale is rated "credited".

If the level according to the results of any current control measure is lower than 60%, then the discipline is rated "Fx" and, if below 35%, then "F". In the case of this national scale, the score is "not taken into account".

10. COMPOSITION OF THE COMPLEX OF TEACHING AND METHODOLOGICAL SUPPORT OF DISCIPLINE

The complex of teaching and methodological support of the discipline should be located on the site of the Department of System Analysis and Management and should contain:

1) work program of discipline;

2) educational content (informational support of lectures);

3) task and methodical provision of laboratory work;

4) materials of the methodological support of independent work of the student concerning:

– preliminary processing of information provision of lectures;

– solving self-control tasks for each topic

5) generalized tasks for the current control of the level of the formation of disciplinary competencies in the form of typical situational exercises with examples of solutions;

6) task for post-certification monitoring of the level of formation of disciplinary competencies.

11. RECOMMENDED LITERARURE

11.1 Basic

1. Paklin N.B. Business Analytics: From Data to Knowledge: Tutorial. Manual / NB Paklin, VI Oreshkov - 2nd ed., Pererab. and add - St. Petersburg: Peter. - 2010. - 704 pp.

2. Snityuk V.E. Prediction: Models. Methods. Algorithms. Tutorial. - K: "MacLeft". - 2008 - 364 pp.

3. Duke V. Data mining: training course / V. Dyuk, A. Samoilenko. - St. Petersburg: Peter. - 2001. - 368 pp.

11.2 Auxiliary

4. Lyuer JF Artificial Intelligence: Strategies and Methods for Solving Complex Problems. - 4th edition: Per. from english - M .: Williams Publishing House, 2003. - 864 pp.

5. Barseghyan AA Data Analysis Techniques: Data Mining, Visual Mining, Text Mining, OLAP / AA Barseghyan, MS Kupriyanov, VV Stepanenko, II Cold. - 2nd ed., Pererab. and add - SPb .: BHV-Petersburg. - 2007. - 384 pp.

Educational edition

Zheldak Timur Anatolievich

WORKING PROGRAM OF EDUCATIONAL DISCIPLINE
"Methodology of scientific research"
for masters of specialty 124 "System analysis"

Issued
at the State Higher Educational Institution
"National Mining University".
Certificate of entry in the State Register of Civil Code № 1842 dated 11.06.2004
49005, Dnipropetrovsk, prosp. K. Marx, 19.