

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
National Aviation University
 Faculty of Air Navigation, Electronics and Telecommunications
 Department of Aviation Computer-Integrated Complexes

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"__" _____ 2022

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"__" _____ 2022



Quality management system

EXTENDED PROGRAM

on

«Expert Systems and Decision Making Theory»

Educational Professional Program: "Computer-Integrated Technological Processes and Production"

Field of study: 15 «Automation and Instrumentation»

Specialty: 151 «Automation and Computer-Integrated Technologies»

Training Form	Semester	Total (hours/credits ECTS)	Lectures	Pract. classes	Lab. classes	Self-study	HT/CGP/CW	TP/CP	Semester Grade
Day Form	2	120/4,0	18	-	18	84	-	-	Graded test-2 s

Index CM - 2 - 151 - 2 / 21 - 3.5



The Extended Program on «Expert Systems and Decision Making Theory» is developed on the basis of the Educational Professional Program «Computer-integrated technological processes and production», Curriculum and Extended Curriculum of Education Seekers Training for «Master» CM - 2 - 151 - 2/21 and ECM - 2 - 151 - 2/21 for the Specialty 151 "Automation and Computer-Integrated Technologies" and corresponding normative documents

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" __ " _____ 2022

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INTRODUCTION

The Extended Program on «Expert Systems and Decision Making Theory» is developed on the basis of "Methodical instructions for the development and design of the Extended Program for the subject", enacted by the order as of 29.04.2021 № 249/од and corresponding normative documents.

1. EXPLANATORY NOTE

1.1. Place, objectives, tasks of the subject.

The place of the subject «Expert Systems and Decision Making Theory» in the system of professional training.

The educational subject refers to the disciplines of free choice of students. The discipline is the theoretical basis of the set of knowledge and skills that form the profile of a specialist in the field of automation and computer-integrated technologies.

The aim of teaching the discipline is to create a set of knowledge on building expert systems and decision-making systems, which will allow solving the design, control and operation of modern systems of technical monitoring of computer-integrated complexes.

Tasks of the discipline are:

- achieving a level of knowledge sufficient for the presentation of knowledge, development of algorithmic and software of modern expert systems;
- formation of practical skills in designing and using expert systems and decision-making systems.

1.2. Learning outcomes the subject makes it possible to achieve.

The study of the academic discipline involves the formation of the following program learning outcomes in the applicants:

- use algorithms of fuzzy conclusions when forming expert assessments and analyze decision-making situations;
- operate modern systems of technical monitoring of computer-integrated complexes.

1.3. Competences the subject makes it possible to acquire.

As a result of studying this discipline, the student acquires the following **program competencies**:

- 3K2 - the ability to generate new ideas (creativity);
- CK3 - the ability to apply modeling and optimization methods to research and improve the efficiency of systems and processes of managing complex technological objects in aviation;
- CK6 - the ability to apply modern methods of automatic control theory for the development of automated control systems;
- CK19 - the ability to develop methods and means of optimizing the technological processes of creation and maintenance of computer-integrated production and automated control systems of aviation equipment.

1.4. Interdisciplinary connections.

The educational discipline «Expert Systems and Decision Making Theory» is based on the knowledge of such disciplines as «Methods of Modeling and Optimization of Systems and Processes», «Applied Identification Theory» and interacts with the discipline «Algorithmic and Information Support of Computer-Integrated Systems», which are studied in parallel with it and complement each other one.



2. COURSE TRAINING PROGRAM ON THE SUBJECT.

2.1. The subject content

The educational material of the subject «Expert Systems and Decision Making Theory» is structured on a modular principle and consists of two educational modules, namely:

- educational **module No. 1 "Expert systems and decision-making systems under conditions of certainty"**;

- educational **module No. 2 "Expert systems and decision-making systems under conditions of uncertainty"**, each of which is logically complete, independent and integral part of the curriculum. Its mastering has in view module test and analysis of its completion.

2.2. Modular structuring and integrated requirements for each module

Module No. 1 "Expert systems and decision-making systems under conditions of certainty"

Integrated requirements of module No 1:

Know:

- knowledge presentation models and acceptance techniques in artificial intelligence systems.

Be able:

- perform processing of expert assessments.

Topic 1. Artificial intelligence systems

Classification of artificial intelligence systems. Expert systems and their classification. Basic functions of expert systems. The structure of the formation of the initial set of alternatives. Decision making techniques.

Topic 2. Knowledge representation models

Classification of knowledge presentation models. Logical models; Production models; Network models; Frame models. Models based on a theoretical approach. Mechanism of logical conclusion.

Topic 3. Search strategies in the space of states

Decision making techniques. Solving the problem by the search method. Heuristic search. Inductive algorithm for building a decision tree. Methods. Acquisition of knowledge. Means of acquiring knowledge. Methods of measuring the degree of influence of objects.

Module No. 2 "Expert systems and decision-making systems under conditions of uncertainty"

Integrated requirements of module No 2:

Know:

- probabilistic stochastic methods of acceptance.

Be able:

- use fuzzy inference algorithms when forming expert assessments.



Topic 1. **Probabilistic stochastic methods in decision-making theory**

A stochastic approach to the description of uncertainty. Uncertainties in expert systems. Subjective probabilities. Bayesian estimation. Language of chances, coefficient of confidence.

Topic 2. **Genetic algorithms**

Basic concepts of genetic algorithms. Classical genetic algorithm. Execution of the classic genetic algorithm. Encoding the problem in the genetic algorithm.

Topic 3. **Fuzzy sets in expert systems**

Application of the theory of fuzzy sets in expert systems. Fuzzy neural networks. Perceptrons and their training. Fuzzy inference algorithms. Programming packages for fuzzy expert systems.

2.3. Training schedule of the subject.

№	Topic	Academic hours			
		Total	Lectures	Lab. classes	Self-study
Module №1 «Expert systems and decision-making systems under conditions of certainty»					
1.1	Artificial intelligence systems	2 semester			
		14	2	2	10
1.2	Knowledge representation models	20	2	2	14
1.3	Search strategies in the space of states	16	2	2	12
1.4	Module test 1	6	-	2	4
Total for Module 1		56	8	8	40
Module №2 «Expert systems and decision-making systems under conditions of uncertainty»					
2.1	Probabilistic stochastic methods in decision-making theory	18	2	2	12
2.2	Genetic algorithms	20	2	2	14
2.3	Fuzzy sets in expert systems	20	2	2	14
2.4	Module test 2	6	-	2	4
Total for Module 2		64	10	10	44
Total for the discipline		120	18	18	84



3. BASIC CONCEPTS OF GUIDANCE ON THE SUBJECT

3.1. Teaching methods

Both subject-oriented and individually-oriented learning technologies are used to activate the educational and cognitive activity of students during the study of the discipline. Laboratory work mainly uses the Case Study method, and lectures and presentations and interactive learning technologies are used.

3.2. List of references

Basic literature

- 3.2.1. М. Негрей, К. Тужик. Теорія прийняття рішень: навчальний посібник. – К.: Центр навчальної літератури, 2018. – 272 с.
- 3.2.2. Савченко А.С. Синельников, О. О. Методи та системи штучного інтелекту: навчальний посібник – К. : НАУ, 2017. – 190 с
- 3.2.3. Федорчук Є. Н. Програмування систем штучного інтелекту. Експертні системи. Видавництво Львівської політехніки, 2012 р.
- 3.2.4. Sean Moriarity. Genetic Algorithms in Elixir: Solve Problems Using Evolution. – Pragmatic Bookshelf, 2021. – 244 .

Additional literature

- 3.2.5. Joseph C. Giarratano, Gary D. Riley. Expert Systems: Principles and Programming, // 4th Edition/ – Course Technology, 2004. – 288 p.
- 3.2.6. Змітрович А.І. Інтелектуальні інформаційні системи. – К, Тетрасистемс, 1997. – 367 с.

3.3 Information resources on the Internet

- 3.3.1 <http://www.infra.kth.se/~soh/decisiontheory>
- 3.3.2 <https://moluch.ru/archive/125/34485/>
- 3.3.3 <http://www.prorobot.ru/nauka/expert>



4. RATING SYSTEM OF KNOWLEDGE AND SKILLS ASSESSMENT

4.1. Assessment of certain types of academic work performed by the student is carried out in points in accordance with table 4.1.

Table 4.1

Type of Academic Work	Maximum Grade Values	Type of Academic Work	Maximum Grade Values
Semester №2			
Module №1 «Expert systems and decision-making systems under conditions of certainty»		Module № 2 «Expert systems and decision-making systems under conditions of uncertainty»	
Execution and defending laboratory works (total)	76×3 = 21	Execution and defending laboratory works (total)	76×3 = 21
Execution of tasks of express control under time of laboratory classes	56×3 = 15	Execution of tasks of express control under time of laboratory classes	56×3 = 15
<i>For carrying out module test №1, a student must receive not less than</i>	22	<i>For carrying out module test №2, a student must receive not less than</i>	22
Module Test №1	14	Module Test №2	14
Total for the Module 1	50	Total for the Module 2	50
Total for modules 1, 2			100
Total for the subject			100

The credit rating is determined (in points and on a national scale) based on the results of all types of educational work during the semester.

4.2. The kind of academic work, performed by a student, has been passed, if a student got positive grade.

4.3. The grades a student has been given for the different kinds of academic work the summed up and the result constituting a Current Module Grade is entered into the Module Grade Register.

4.4. In the case of **Graded test**, the sum of the final semester module grade in points constitutes the final semester rating grade, which is converted into a grade based on the national scale and the ECTS scale.

4.5. The Total Semester Grade is entered into the credit and examination information, the study card and into the student's record book, for example: **92/Ex/A**, **87/Good/B**, **79/Good/C**, **68/Sat/D**, **65/Sat./E**, etc.

4.6. The Total Subject Grade corresponds to the Total Semester Grade. The Total Subject Grade is entered in the Diploma Supplement.



(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				