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

AGREED

Dean of Faculty of Air Navigation, Electronics and Telecommunications

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"___"_____ 2022

APPROVED

Vice-Rector for Academics

_____ Anatolii POLUKHIN

"___"_____ 2022

Quality management system

EXTENDED PROGRAM
on
"Algorithmic and Information Support of Computer-Integrated Systems"

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	Seme-ster	Total (hours/credits ECTS)	Lec-tures	Pract. classes	Lab. classes	Self-study	HT/ CGP/ CW	TP/CP	Semester Grade
Day Form	2	210/7,0	36	-	36	138	-	TP-2s	Exam-2s

Index CM - 2 - 151 - 2 / 21 - 2.1.6

The Extended Program on «Algorithmic and Information Support of Computer-Integrated Systems» 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

Developed by:
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Discussed and approved by the Graduate Department for Specialty 151 «Automation and Computer-Integrated Technologies», Educational Professional Program «Computer-Integrated Technological Processes and Production» – Aviation Computer-Integrated Complexes Department, Minutes № __ of « » _____2022.

Guarantor
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The Extended Program was discussed and approved by the Scientific-Methodical-Editorial Board of the Faculty of Air Navigation, Electronics and Telecommunications, Minutes №___ as of «___» _____ 2022

Head of the SMEB _____ Olexander KRYVONOSENKO

Vice Rector on International
Collaboration and Education

_____ Iryna ZARUBINSKA

"___"_____ 2022

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CONTENT

INTRODUCTION

The Extended Program on «Algorithmic and Information Support of Computer-Integrated Systems» 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/od and corresponding normative documents.

1. EXPLANATORY NOTE

1.1. Place, objectives, tasks of the subject.

The place of the subject «Algorithmic and Information Support of Computer-Integrated Systems» in the system of professional training**.**

This subject is the theoretical basis of the set of knowledge and skills that form the aviation profile of a specialist in the field of automation and computer-integrated technologies.

The aim of teaching the discipline is creation of a set of knowledge on issues of construction and features of the functioning of computer-integrated systems (CIS). The acquired knowledge allows solving issues of design, research, control and operation of modern CIS.

The tasks of the discipline is:

- achieving a level of knowledge sufficient to solve the tasks of development and analysis of algorithmic and information support of modern CIS;
- formation of practical skills in research, certification and operation of complex aviation computer-integrated complexes.

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

The study of the academic discipline involves the formation of program learning outcomes for applicants in accordance with the educational and professional program "Computer-integrated technological processes and production", in particular:

ПР02 - to create highly reliable automation systems with a high level of functional and information security;

ПР13 - to service and repair aviation systems and complexes, computer-integrated production;

ПР10 - develop and use specialized software and digital technologies to create automation systems of complex technical objects, professionally own special software tools;

ПР15 - to understand various tools and strategies relevant to the diagnosis of computer-integrated production and automated control systems of aviation equipment.

1.3. Competences the subject makes it possible to acquire.

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

- ІК - the ability to solve complex tasks and problems of automation and computer-integrated technologies in professional activities;
- ЗК1 - the ability to conduct research at the appropriate level;
- ЗК2 - the ability to generate new ideas (creativity);
- ЗК3 - the ability to abstract thinking, analysis and synthesis;
- СК1 - the ability to automate complex aviation complexes, create cyber-physical systems of aviation navigation based on intelligent management methods and digital technologies;
- СК2 - the ability to design and implement highly reliable piloting and navigation complexes of aircraft and their application software, for the implementation of management functions and information processing;
- СК3 - the ability to apply modeling and optimization methods to research and improve the efficiency of systems and processes of managing complex technological and organizational-technical objects in aviation;
- СК5 - the ability to integrate knowledge from other fields, apply a systematic approach and take into account non-technical aspects when solving engineering problems and conducting scientific research.

1.4. Interdisciplinary connections.

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

2. COURSE TRAINING PROGRAM ON THE SUBJECT.

2.1. The subject content

The educational material of the subject «Algorithmic and Information Support of Computer-Integrated Systems» is structured on a modular principle and consists of two educational modules, namely:

- educational **module No. 1 "Information and navigation systems "**;
- educational **module No. 2 "Algorithms of integration and computer-integrated information and navigation systems"**, 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.

A separate **3rd module** (educational component) is a Term Paper (TP), which is completed in the 2-nd semester. TP is an important component of consolidation and deepening of theoretical and practical knowledge and skills acquired by the student in the process of assimilation of the educational material of the discipline

2.2. Modular structuring and integrated requirements for each module

Module No. 1 " Information and navigation systems "

Integrated requirements of module No 1:

Know:

- principles of construction and algorithm of operation of information and navigation systems as part of on-board equipment.

Be able:

- carry out verifications and research of individual information and navigation systems.

Topic 1. **« Information and navigation systems as part of on-board equipment»**

Subject of discipline. General Information. Methods of determining aerobatic and navigational flight parameters. Classification of information and navigation systems.

Topic 2. **« Inertial navigation systems»**

Principles of construction of platform inertial navigation systems (INS). Operating modes of platform INS. Exhibition of platform INS. Principles of construction of strapdown inertial navigation systems (SINS). Three-component SINS.

Topic 3. **« Autonomous radio technical information systems»**

Low-altitude radio altimeters. Purpose and principles of operation of radio altimeters. Errors of radio altimeters. The principle of construction of Doppler measuring devices of road speed and angle of drift of the ДИСС type. The algorithm of ДИСС work. Radar stations surveying the earth's surface. The principle of operation of meteorological navigation radar stations.

Topic 4. **« Radio beacon navigation systems»**

The short-range radio navigation system of the РСБН type and its analogue - the VOR/DME radio navigation system. Long-range radio engineering systems: phase radio navigation systems of the «Omega» type and pulse-phase radio navigation systems of the РСДН-10, «Loran-C» type. Principles of building satellite radio-navigation systems (SNS). Algorithmic provision of SNS. Principles of construction of the ILS/СП landing system. Structural features of the MLS microwave landing system.

Module No. 2 "Algorithms of integration and computer-integrated information and navigation systems "

Integrated requirements of module No 2:

Know:

- algorithms of complex information processing in aviation computer-integrated systems;
- methods of correction of navigation systems and principles of construction of separate computer-integrated navigation systems.

Be able:

- perform research on complex information processing algorithms.

Topic 1. **«Algorithms of complex information processing»**

Filtering and compensation schemes. Least squares estimation algorithm. Algorithm of evaluation by the method of maximum likelihood. Recurrent method of information processing. General formulation of the problem of optimal complexation. Algorithm of continuous optimal Kalman filter. Discrete Kalman filter.

Topic 2. «**Interconnecting and correction of navigation systems»**

Complex inertial-Doppler method of determining road speed. ANN correction from the speed corrector. ANN correction from the positional corrector. Correction of numerous coordinates and course of the aircraft according to ground landmarks. Correction of unstable vertical ANN channel: estimation of vertical speed; estimate of average true flight height. Optimal estimation of height and vertical speed in air-inertial navigation systems.

Topic 3. **«Integrated and correlation-extreme navigation systems»**

Inertial satellite navigation systems. Schemes of construction of integrated inertial-satellite navigation systems. Algorithmic provision of complexing procedures in inertial-satellite navigation systems. Astro and astroinertial means of navigation. Principles of construction of astroinertial navigation systems. Correlation-extreme navigation systems (CENS): classification of geophysical fields by which correlation-extreme navigation is carried out; correction of navigational calculation systems based on terrain relief data; variants of structures of existing CENS.

Module No. 3. « Term Paper »

The aim of the TP is to synthesize the contours of speed and positional correction of the inertial navigation system and to investigate them analytically and by means of mathematical modeling of the processes

To successfully complete the TP, you need to know the analytical model of the inertial navigation system and the method of error analysis of the inertial navigation system. Synthesized contours of speed and positional correction are studied by means of mathematical modeling in order to analyze the evolution of errors of the inertial navigation system.

2.3. Training schedule of the subject.

№	Topic	Academic hours			
		Total	Lectures	Lab. classes	Self-study
Module №1 «Information and navigation systems»					
1.1	Information and navigation systems as part of on-board equipment	**2-nd semester** 20	2 2	2 2	12
1.2	Inertial navigation systems	28	2 2 2	2 2	18
1.3	Autonomous radio technical information systems	22	2 2	2 2	14
1.4	Radio beacon navigation systems	22	2 2 2	2 2	12
1.5	Module test 1	6	-	2	4
	Total for Module 1	**98**	**20**	**18**	**60**
Module №2 «Algorithms of integration and computer-integrated information and navigation systems»					
2.1	Algorithms of complex information processing	28	2 2	2 2 2 2	16
2.2	Interconnecting and correction of navigation systems	24	2 2 2	2 2	14
2.3	Integrated and correlation-extreme navigation systems	24	2 2 2	2 2	14
2.4	Module test 2	6	-	2	4
	Total for Module 2	**82**	**16**	**18**	**48**
Module №3 «Term Paper»					
3.1	Synthesis of correction contours of the platform inertial navigation system	30	-	-	30
	Total for Module 3	**30**	**-**	**-**	**30**
	Total for 2-nd semester	**210**	**36**	**36**	**138**
	Total for the discipline	**210**	**36**	**36**	**138**

2.4. Questions List for Examination

The list of questions and the content of tasks for preparation for the exam are developed by the leading teacher of the department in accordance with the work program, approved at the meeting of the department and brought to the attention of students.

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 Рогожин В.О., Скрипець А.В., Філяшкін М.К., Мухіна М.П. Автономні системи навігації конкретного типу повітряного судна та їх технічне обслуговування: навч. посібник. – К.: НАУ, 2015. – 308 с.

3.2.2 В.О.Рогожин, В.М. Синєглазов, М.К. Філяшкін Пілотажно-навігаційні комплекси повітряних суден: Підручник. – К. НАУ, 2005. – 316 с.

Additional literature

3.2.3 Захарін Ф.М., Синєглазов В.М., Філяшкін М.К. Алгоритмічне забезпечення інерціально-супутникових систем навігації: Монографія. К., НАУ, 2011.

3.2.4 V.M. Sineglazov, F.M. Zacharin, M.K. Filyashkin Computer-Integrated Navigation Complex of Unmanned Aerial Vehicles / “Methods and Systems of Navigation and Motion Control”: International Conference, October, 13-16, 2010. – K.: «Osvita Ukrainy», 2010. – P. 4 - 8.

3.3 Information resources on the Internet

3.3.1 http://dic.academic.ru/dic.nsf/enc_tech/1559/

3.3.2 http://www.razlib.ru/tehnicheskie_nauki/sverhzvukovye_samolety

3.3.3 http://www.flxsys.com/aerospace.shtml

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 «Information and navigation systems»		**Module № 2** «Algorithms of integration and computer-integrated information and navigation systems»	
Execution and defending laboratory works (total)	7б×4 = 28	Execution and defending laboratory works (total)	7б×4 = 28
For carrying out module test №1, a student must receive not less than	*17*	*For carrying out module test №2, a student must receive not less than*	17
Module Test №1	12	Module Test №2	12
Total for the Module 1	40	**Total for the Module 2**	40
		Total for modules 1, 2	**80**
		Semester exam	**20**
		Total for the subject	**100**

Continuation of the Table 4.1

Module №3 «Term Paper»	
Type of Academic Work	Maximum Grade Values
Semester №1	
Execution of the Term Paper	60
Defending of the Term Paper	40
Execution and defending of the Term Paper	**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. The total modular grade obtained by the student based on the results of the execution and defense of the Term Paper in values, according to the national scale and the ECTS scale, is entered in the information of the module control, as well as in the study card, the score book and in the Diploma Supplement, for example, as follows: ***94/Ex/A, 85/Good/B, 78/Good/C, 68/Sat/D, 66/Sat./E***, etc.

4.5. The Semester Module Grade and the examination grade are summed up and recalculated according to the National system and ECTS.

4.6. 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.

4.7. 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 ознайом-лення	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	Анульо-ваного			

(Ф 03.02 – 32)

УЗГОДЖЕННЯ ЗМІН

	Підпис	Ініціали, прізвище	Посада	Дата
Розробник				
Узгоджено				
Узгоджено				
Узгоджено				
Узгоджено				
Узгоджено				