Ministry of Education and Science of Ukraine
National Aerospace University
"Kharkiv Aviation Institute"

Department of Aircraft Control Systems (Dep. 301)

APPROVED:
Guarantor of Educational Program
_____ A. S. Kulik
«_27_» _____08_____ 2021

WORK PROGRAM OF THE COMPULSORY DISCIPLINE

Introduction to Avionics
(name of the discipline)

Field of Study: 17 "Electronics and Telecommunication"

Program Subject Area: 173 "Avionics"

Educational Program: Systems of Autonomous Navigation and Adaptive Control of Aircrafts
(code number and the name of specialization)

Level of Qualification: 1st (bachelor degree)

Kharkiv 2021

Work program of compulsory discipline "Introduction to Avionics" is for English-speaking students of training direction 173 "Avionics".

«_27_» ___08__ 2021, 14 p.

Developer:
I.V. Bychkova, senior lecturer of dep. 301 _____ (sign)

The work program has been examined at the meeting of dep. 301 "Aircraft Control Systems".

Record of proceeding: No. "1" from «_27_» ___08___ 2021

Head of the department
PhD (Engineering), Candidate of Science _____ (sign) K. Yu. Dergachov

1. Course description

<table>
<tr><td rowspan="2">Indices</td><td rowspan="2">Field of study, Program subject area, educational program</td><td>Course specification</td></tr>
<tr><td>Full-time study</td></tr>
<tr><td>ECTS credits – 3</td><td rowspan="3">Branch of Education:
17 – Electronics and Telecommunication</td><td>Professional training subject</td></tr>
<tr><td>Modules – 2</td><td rowspan="2">Calendar year:</td></tr>
<tr><td>Semantic modules – 3</td></tr>
<tr><td rowspan="2">Individual Assignment
_____
(topic name)</td><td rowspan="4">Program subject area:
173 – Avionics</td><td>2019/2020</td></tr>
<tr><td>Semester</td></tr>
<tr><td rowspan="2">Total hours – 24/90</td><td>1</td></tr>
<tr><td>Lectures</td></tr>
<tr><td rowspan="3">Academic hours per day for full-time study:
contact (in class) – 1.5;
self-study – 4.125.</td><td rowspan="2">Educational Program:
Systems of Autonomous Navigation and Adaptive Control of Aircrafts</td><td>16 hrs</td></tr>
<tr><td>Tutorial classes</td></tr>
<tr><td rowspan="2">Level of qualification:
1st (bachelor degree)</td><td>8 hrs</td></tr>
<tr><td>Lab classes</td></tr>
<tr><td>-</td></tr>
<tr><td>Self-study work</td></tr>
<tr><td>66 hrs</td></tr>
<tr><td>Assessment form</td></tr>
<tr><td>Pass</td></tr>
</table>

Note:
ratio of classroom working and unaided (self-study) work makes: 24/90 (under full-time education).

2. Purpose and objectives of academic discipline

Learning Aims – provide a general understanding of the specialty subject. Develop the ability to research the properties of the simplest automatic control systems and the primary skills of professional communication.

Training objectives - to give students a systematic knowledge of objects and subjects of specialty, to introduce with navigation systems, avionics, basic principles of control, systems of automatic control, characteristics of ACS, mathematical programs (Matlab, Maple).

Learning Outcomes

On successful completion of the subject, students

should know:

- basic satellite navigation systems, principles of their operation;
- navigation tasks;
- the modern composition of the aircraft avionics system;
- principles of automatic control;
- tasks of automatic stabilization systems;
- possibilities of modern mathematical software;

should be able to:

- work with the EPSPak-I navigation receiver, with a laboratory bench in the "Automatic Control Theory" laboratory room;
- to use computer technology for solving mathematical problems using specialized software packages.

Interdisciplinary Relations:

Prerequisites for studying this discipline:

Higher Mathematics: differential and integral calculus; function research; matrix.

Physics: Laws of Mechanics and Electricity.

The course supports the following courses:

Control Systems Designing, Fundamentals of Navigation, Automatic Control Theory.

3. Content of the course (Course syllabus)

Module 1.

Semantic Modulus 1. Introduction to Learning.

Topic 1. Introduction to the discipline.

Introduction to the discipline. High school. Educational process at the university and at the department.

Topic 2. Navigation. Satellite navigation systems.

The concept of navigation. The main tasks of navigation. Types of navigation. Satellite navigation systems.Semantic Modulus.

Topic 3. Avionics.

Basic concepts. History of development. Modern composition of aircraft avionics.

Semantic Modulus 2. Fundamentals of automatic control theory.

Topic 4. Automatic control systems.

Basic concepts. Control problems. Examples of functional elements of the ACS. Principles of automatic control.

Topic 5. Stabilization of physical quantities.

Basic concepts. Characteristics of the ACS. Model characteristics. Time characteristics. Static characteristic.

Topic 6. Static characteristics of ACS.

Graphical linearization of static characteristics: by tangent and secant.

Module 2.

Semantic Modulus 3. Applied mathematical programs.

Topic 7. Application packages used for calculations and modeling of control systems.

Introduction to Matlab. Basic concepts. Types of used data.

Topic 8. Charting in MATLAB. Solution of differential equations, calculation of integrals, derivatives.

4. The structure of the discipline

Semantic modules and topics	Hours				
	Total	Among them			
		Lec.	Pr.	Lab.	self-study
1	2	3	4	5	6
Module 1					
Semantic Modulus 1. Introduction to Learning					
Topic 1. Introduction to the discipline	12	2			10
Topic 2. Navigation. Satellite navigation systems	14	2	2		10
Topic 3. Avionics	14	2			12
Total for semantic modulus 1	40	6	2		32
Semantic Modulus 2. Fundamentals of automatic control theory					
Topic 4. Automatic control systems	9	2	2		5
Topic 5. Stabilization of physical quantities	9	2	2		5
Topic 6. Static characteristics of ACS.	8	2			6
Test	2				2
Total for semantic modulus 2	28	6	4		18
Total	68	12	6		50
Module 2					
Semantic Modulus 3. Applied mathematical programs					
Topic 7. Application packages used	12	2	2		8

for calculations and modeling of control systems					
Topic 8. Charting in MATLAB. Solution of differential equations, calculation of integrals, derivatives	8	2			6
Test	2				2
Total for semantic modulus 3	22	4	2		16
Pass					
Course total	**90**	**16**	**8**		**66**

5. Topics of seminar classes

№ a/o	Topic name	Hours
1	Not appointed	–
	Total hours	–

6. Topics of lab classes

№ a/o	Topic name	Hours
	Not appointed	
	Total hours	

7. Topics of tutorials

№ a/o	Topic name	Hours
1	Investigation of ESPak-I GPS-receiver and Novatell software capabilities	2
2	Study of ACS implementing the principle of control by the reference action	2
3	Graphical linearization of static characteristics	2
4	Working environment of the Matlab. Simplest mathematical calculations	2
Total		8

8. Self-study (unaided works)

№ a/o	Topic name	Hours
1	Navigation. Satellite navigation systems.	10
2	Technical vision systems.	10
3	Avionics. Traffic Colision Avoidance System.	6
4	Block structure of avionics systems.	6
5	Automatic control systems	12
6	Graphical linearization of static characteristics	6
7	Working environment of the Matlab.	10
8	Working environment of the Maple.	6
	Total	**66**

9. Individual task:

10. Learning methods

Verbal – visual: lectures, practical: laboratory and practical works, individual consultations (if necessary), independent work of students on materials published by the department (methodical manuals).

11. Control methods

Current control – in accordance with the content modules and topics in the form of a written test; oral questioning.

Semester control – in the form of a written pass.

12. Criteria for evaluation and distribution of marks that students receive

12.1. Distribution of marks that students receive

Semester 5

Components of educational work	Marks per lesson (task)	Number of lessons (tasks)	Total mark
Module 1			
Work on lectures	0…1	6	0…6
Execution and submitting of practical works	1…15	3	3…45
Test	1…16	1	1…16
Module 2			
Work on lectures	0…1	2	0…2
Execution and submitting of practical works	1…15	1	1…15
Test	1…16	1	1…16
Total for semester 60… 100			

The ticket consists of theoretical questions. Example.

Theoretical questions:

1. Satellite navigation systems.
2. Linearization by tangent.
3. Matlab functions for equations solving.

12.2. Qualitative evaluation criteria

The required amount of knowledge to receive a positive evaluation:

concepts and principles of operation of satellite navigation systems, systems of technical vision, modern composition of aircraft avionics, principles of automatic control, basics of work in Matlab and Maple.

The required amount of skills to obtain a positive evaluation: be able to work with the EPSPak-I navigation receiver and Novatell software, to receive static charac-

teristics of ACS functional elements, perform linearization, perform simple calculations in Matlab and Maple.

Rating scale: national and ECTS

Total points	Score on the traditional scale	
	Exam	Pass
90 – 100	excellent	Passed
75 – 89	good	
60 -74	satisfactory	
0 – 59	not satisfactory	not passed

13. Methodological support

1. Summary of lectures.
2. All materials on discipline are posted on the server of Department 301.

14. Recommended reading

Basic

1. GNSS – Global Navigation Satellite Systems: GPS, GLONASS, Galileo, and more/ Bernhard Hofmann-Wellenhof, Herbert Lichtenegger, Elmar Wasle. – Kindle Edition, 2008. – 516p.

2. Збірник задач із систем автоматичного управління / О.Г.Гордін, К.Ю.Дергачов, В.Г.Джулгаков та ін.; під заг. ред. А.С. Куліка, В.Ф. Симонова. – Х.: Нац. аерокосм. ун-т «Харк. авіац. ін-т», 2009. – 206с.

3. Авіоніка: навч. посіб. / В.П. Харченко, І.В. Остроумов. – К. : НАУ, 2013. – 272 с.

4. Основы построения современных мобильных систем технического зрения [Текст]: учеб. пособие (часть 2)./Л. А. Краснов, К. Ю. Дергачев, С. В. Багинский– Х.: Нац. аэрокосм. ун-т им. Н.Е. Жуковского «Харьк. авиац. ин-т», 2018. – 92 с.

Complementary reading

1. Matlab: A Practical Introduction to Programming and Problem Solving/Stormy Attaway. – College of Engineering, Boston University Boston, MA, 2009. – 452 p.

15. Information resources

1. **Department site**: k301.info.
2. https://www.mathworks.com/