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

Department of Aircraft Control Systems (Dep. 301)

APPROVED:
Guarantee of the educational program
_____ A.Kulik
"27" 08 2021

WORK PROGRAM OF THE COMPULSORY DISCIPLINE

FUNDAMENTALS OF AIR TRAFFIC CONTROL

Field of Study: 17 – Electronics and Telecommunication

Program Subject Area: 173 – Avionics

Educational Program: Systems of Autonomous Navigation and Adaptive Control of Aircrafts

Level of Qualification: 1st (bachelor degree)

Kharkiv 2021

The developed study program of compulsory discipline «Fundamentals of Air Traffic Control» is for English-speaking students of training direction 173 – Avionics

"27" August 2021 – 10 p.

Developers: Dergachov K.Yu., associate professor of the department 301, Candidate of science (Engineering) _____.
(sign)

Bahinskii S.V., assistant of the department 301 _____.
(sign)

The program has been examined at the meeting of dep. 301 «Aircraft Control Systems».
Record of proceeding № 1 " 27 " August 2021

Head of the department
Associate professor, PhD (Engineering) _____ K.Yu. Dergachov
(sign)

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 – 4.5</td><td rowspan="3">Branch of Education:
17 – Electronics and Tele-communication</td><td>Professional training subject</td></tr>
<tr><td>Modules – 2</td><td rowspan="2">Calendar year:</td></tr>
<tr><td>Semantic modules – 5</td></tr>
<tr><td rowspan="3">Individual Assignment
_____
(topic name)</td><td rowspan="5">Program subject area:
173 – Avionics</td><td>2021/2022</td></tr>
<tr><td>Semester</td></tr>
<tr><td rowspan="2">8</td></tr>
<tr><td rowspan="2">Total hours – 60/135</td><td rowspan="2">Educational Program:
Systems of Autonomous Navigation and Adaptive Control of Aircrafts</td><td>Lectures</td></tr>
<tr><td>24 hrs</td></tr>
<tr><td rowspan="3">Academic hours per day for full-time study:
contact (in class) – 4,5;
self-study – 4,6875.</td><td rowspan="3">Level of qualification:
1st (bachelor degree)</td><td>Tutorial classes</td></tr>
<tr><td>12 hrs</td></tr>
<tr><td>Lab classes</td></tr>
<tr><td>24 hrs</td><td>Self-study work</td></tr>
<tr><td>75 hrs</td><td>Assessment form</td></tr>
<tr><td>Pass</td></tr>
</table>

Note:
ratio of classroom working and unaided (self-study) work makes: 75/135 (under full-time education).

2. Purpose and objectives of academic discipline

Learning Aims – the study of technologies, methods and algorithms for the solution of the basic functional problems of air traffic control.

Training objectives - the study of the tasks of the ATC, the main documents of the ICAO on flight service, airspace organization, flight rules, air traffic control services, the application of radar systems for the ATC, the influence of the human factor on the ATC, the system of separation.

Learning Outcomes

On successful completion of the subject, students

should know:

- problems of air traffic control;
- the contents of ICAO documents on flight service;
- rules of separation;
- principles of visual flight and instrument flight;
- classification of dispatching points;
- airspace zoning rules;
- influence of the human factor on flight safety, SHELL-model;

should be able to:

- perform before flight planning and fill flight plan;
- to apply analytical methods of analysis of the influence of operational factors on take-off and landing characteristics of an airplane;
- perform the simulation of the algorithm of secondary data retrieval in the automatical flight;
- to determine the time and place of the beginning of the decrease on the route in order to reduce waiting time over the aerodrome of landing;
- perform coordinate transformation.

Interdisciplinary Relations:

Prerequisites for studying this discipline:

Fundamentals of Navigation: coordinate systems; satellite navigation systems; radio navigation systems.

Calculation Methods and Simulation Techniques: basics of working with Matlab.

The course supports the following courses:

Control Systems Designing.

Coursework and diploma work.

3. Content of the course (Course syllabus)

Module 1.

Semantic Modulus 1. General principles of air traffic control

Topic 1. Introduction to Air Traffic Control.

History of air traffic control. Air Traffic Control Complex.

Topic 2. International Civil Aviation Organization (ICAO).

Basic air traffic co ntrol services. International Civil Aviation Organization (ICAO). Basic air traffic control se rvices.

Module 2.

Semantic Modulus 2. Airspace organization

Topic 3. Flight level.

Transition altitude. Vertical separation. Horizontal separation.

Topic 4. Flight planning.

Basic terms. Measuring devices. Describe the route. Flight plan. Spare aerodromes. Flight Plan (FAA standard form).

Topic 5. Airspace classification. Visual flight rules.

Controlled airspace. Uncontrolled airspace. Airspace for special purposes. Other types of airspace. Visual flight rules.

Topic 6. Instrument flight rules.

Instrumental panel. Take off and landing.

Module 3.

Semantic Modulus 3. Using radar systems in ATC.

Topic 7. Omni-directional azimuth radio beacon (VOR).

The principle of VOR. Types of VOR Accuracy and reliability. Examples of use.

Topic 8. Omni-directional range beacon (DME).

The principle of DME. Aircraft equipment. Using DME.

Module 4.

Semantic Modulus 4. Communication, observation and meteorological services.

Topic 9. Signal lights for aircraft.

ICAO rules. Types of lamps. Placement of signal lights on the hole-roof. Examples of the location of the lights.

Topic 10. Traffic collision avoidance system.

TCAS basics. Advisories. System components. Operation. TCAS Versions. Current limitations.

Topic 11. Meteorological Service.

METAR's actual weather report. Transmissions of ATIS / VOLMET type.

Semantic Modulus 5. Human factor

Topic 12. Human factor in aviation security. Model SHELL.

Human factor. Model SHELL. Components of the SHELL model. Using the SHELL model.

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. General principles of air traffic control					
Topic 1. Introduction to Air Traffic Control	11	2			9
Topic 2. International Civil Aviation Organization (ICAO)	17	2	2	4	9
Total for semantic modulus 1	28	4	2	4	18
Semantic Modulus 2. Airspace organization					
Topic 3. Flight level	12	2	2	4	4
Topic 4. Flight planning	9	2	2		5
Topic 5. Airspace classification. Visual flight rules	8	2		2	4
Topic 6. Instrument flight rules	6	2			4
Test	2				2
Total for semantic modulus 2	37	8	4	6	19
Total	65	12	6	10	37
Module 2					
Semantic Modulus 3. Using radar systems in ATC					
Topic 7. Omni-directional azimuth radio beacon (VOR)	10	2			8
Topic 8. Omni-directional range beacon (DME)	16	2	2	4	8
Total for semantic modulus 3	26	4	2	4	16
Semantic Modulus 4. Communication, observation and meteorological services					
Topic 9. Signal lights for aircraft	9	2		4	5
Topic 10. Traffic collision avoidance system	13	2	2	4	5
Topic 11. Meteorological Service	6	2			4
Total for semantic modulus 4	28	6	2	8	14
Semantic Modulus 5. Human factor					
Topic 12. Human factor in aviation security. Model SHELL	12	2	2	2	6
Test	2				2
Total for semantic modulus 5	14	2	2	2	8
Total	70	12	6	14	38
Pass					
Course total	135	24	12	24	75

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
1	Modeling of secondary data processing with automatic flight support	4
2	Research of coordinate transform algorithms	4
3	Analysis of the influence of operating factors on the take-off of aircraft	4
4	Analysis of the influence of operational factors on aircraft landing	4
5	Research of the methods of determining the position of the aircraft according to course data	4
6	Determining the capacity of the air traffic control stations	4
Total		24

7. Topics of tutorials

№ a/o	Topic name	Hours
1	Main concepts of ICAO. Annex 11 Air traffic Services	2
2	Determining the time and place of beginning of aircraft's descending en route to reduce residence time over the landing airport	2
3	Determine time and distance climbing height for assigned flight level	2
4	Air traffic control using Surveillance Radars	2
5	Determining the ground speed of an aircraft flying in any direction	2
6	Terminal radar approach control facility (Surveillance Radar)	2
Разом		12

8. Self-study (unaided works)

№ a/o	Topic name	Hours
1	History of air traffic control	5
2	International Civil Aviation Organization (ICAO)	10
3	Flight level	6
4	Flight Plan (USA). Flight Plan	6
5	Classification of airspace	7
6	Rules for flying devices	6
7	Omni-directional azimuth radio beacon	6
8	Omni-directional range beacon	6
9	Rules for placing signal lights for aircraft	5
10	Meteorological Service	8
11	Human factor in aviation security. Model SHELL	5
12	History of air traffic control	5
	Total	**75**

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 submiting of laboratory works	1...5	3	3...15
Execution and submiting of practical works	1...5	3	3...15
Test	1…14	1	1…14
Module 2			
Work on lectures	0…1	6	0…6
Execution and submiting of laboratory works	1...5	3	3...15
Execution and submiting of practical works	1...5	3	3...15
Test	1…14	1	1…14
Total for semester 60… 100			

The exam ticket consists of theoretical and practical questions. Example.

Theoretical questions:

1. ICAO Appendices.
2. Classification of airspace.
3. Components of the Traffic Collision Avoidance System (TCAS).

Practical questions:

1. The AN-140 given flight level H_{760}; height departing from the airport H_{dep}. Barometric pressure of landing airport is P_0; the estimated average ground speed on the climbing W_{climb}; and the vertical rate speed of climbing is U; time departing

from the airport T_{dep}. Determine the final time $T_{f.c.}$ and distance S_{climb} during climbing.

Table 1 – Variants of data

№	FL, m	T_{dep}	P_0, mm Hg	H_{dep},m	W, km / h	U, m / s
1	2500	14:25	740	300	450	2
2	2800	18:30	745	600	390	4
3	3100	15:20	760	400	370	5
4	4500	08:25	750	600	470	6

2. Aircraft flight on altitude 3000m with true airspeed V_{true}=320km/h and actual ground speed W_{actual}=340km/h. Tower controller determine motion of aircraft in 16 h 40 min on 21-th scale circle use PPI.

Determine required ground speed and true airspeed, to arrived at the landing airport following schedule in 17 h 15 min.

12.2. Qualitative evaluation criteria

The required amount of knowledge to receive a positive evaluation:

concepts and principles of air traffic control task, content of ICAO documents on flight service, separation rules, principles of visual and instrument flight, classification of control points, airspace zoning rules, human factor influences on flight safety, SHELL model.

The required amount of skills to obtain a positive evaluation: have practical skills in applying analytical methods of analyzing the impact of operational factors on the take-off and landing characteristics of the aircraft, performing the algorithm of secondary data processing with automatic flight support, determining how aircraft take off and take off it is affected by the transformation of coordinate systems.

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. International Civil Aviation Organization: Annexes 1-18.
2. В.П. Харченко, Г.Ф. Аргунов, О. Є. Луппо / Обслуговування повітряного руху на цивільних аеродромах України: навч. посіб./ К.: Вид-во нац. авіац. ун-ту «НАУ-друк», 2013. – 250 с.
3. The Advanced Avionics Handbook. U.S. Department of Transportation FEDERAL AVIATION ADMINISTRATION Flight Standards Service, 2009. – 115p.
4. Michael S. Nolan Fundamentals of Air Traffic Control – 5th Edition – Hardcover, 2010. – 654 p.

Complementary reading

1. Guide to IAA Air Traffic Management Operations. 24p.

15. Information resources

1. **Department site**: k301.info.
2. http://uksatse.ua/index.php?s=fa2fd909ae9a2bf3eb89ab204c35dd6e&act=Part&CODE=309&lang=en
3. https://www.skybrary.aero/index.php/Air_Traffic_Control_Service