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

Department of Aircraft Control Systems (Dep. 301)

APPROVED:
Leader of the Project Group
_____ A. S. Kulik
«_29_» ___08_____ 2020

WORKING PROGRAM OF THE COMPULSORY DISCIPLINE

Onboard Networks of Avionics Systems

(code and 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

Form of study: full-time

Level of Qualification: 1st (bachelor degree)

Kharkiv 2020

Study program of compulsory discipline "Onboard Networks of Avionics Systems" is for English-speaking students of training direction 173 "Avionics".

«____» _____ 2020, 11 p.

Developer: Dzylhakov V.G., associate professor of department 301, Candidate of Science (Engineering)

_____
(sign)

Kosterna O. Yu., assistant of dep. 301

_____
(sign)

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

Record of proceeding: No. " 1 " from «28» 08 2020

Head of the department
PhD (Engineering), Candidate of Science _____ 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, Level of Qualification</td><td>Course specification</td></tr>
<tr><td>Full-time study</td></tr>
<tr><td>ECTS credits – 4,5</td><td rowspan="3">Field of Study
17 “Electronics and Telecommunication”</td><td>Compulsory</td></tr>
<tr><td>Modules – 1</td><td>Calendar year:</td></tr>
<tr><td>Substantial modulus – 4</td><td rowspan="3">2020/21</td></tr>
<tr><td rowspan="3">Research into the topic
_____
(name)</td><td rowspan="3">Program Subject Area
173 “Avionics”</td></tr>
<tr><td>Semester</td></tr>
<tr><td>6</td></tr>
<tr><td>Total hours – 64/135</td><td rowspan="3">Educational Program
Systems of Autonomous Navigation and Adaptive Control of Aircrafts</td><td>Lectures</td></tr>
<tr><td rowspan="5">Academic hours per week for full-time study:
classroom – 4,
self-preparation – 4,4.</td><td>32</td></tr>
<tr><td>Tutorial classes</td></tr>
<tr><td rowspan="6">Level of Qualification:
1st (bachelor degree)</td><td>-</td></tr>
<tr><td>Lab classes</td></tr>
<tr><td>32</td></tr>
<tr><td>Self-study (unaided) work</td></tr>
<tr><td>71</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:
64/71 (under full-time education).

2. Purpose and objectives of academic discipline

Learning Aims – studying the general functions and architecture of computer networks of local and global scale, as well as network processes and technologies at the physical level and the logical level of routing and protocols.

Learning Objectives – development of skills for designing the main types of computer networks, configuration and maintenance of network equipment, work with network services, evaluation and provision of a given level of network security.

According to the requirements of the educational-professional program, students shuld achieve the following **competencies**:

GC1. The ability to abstract thinking, analysis and synthesis.

GC 3. The ability to communicate in a foreign language.

GC 5. The ability to learn and master a modern knowledge.

GC 6. The ability to search, process and analyze information from various sources.

GC 8. The ability to make informed decisionsю

GC 11. The ability to work independently.

GC 12. Skills safe implementation activities.

PCS1. The ability to use basic knowledge of major national, European and international regulations in the field of avionics in order to continuously improve their professional activities.

PCS 3. The ability to implement and use hardware and algorithmic tools to increase the accuracy and reliability of control systems and other qualities of the aircraft.

PCS 4. The ability to develop technical specifications for the design and manufacture of aircraft and management of technological equipment, choice of equipment and technological equipment.

PCS 6. Вміння аналізувати системи авіоніки, формувати архітектуру систем навігації та автоматичного управління літальних апаратів, виділяти підсистеми, що є складовими загальної системи та взаємозв'язки поміж ними.

PCS 7. The ability to analyze systems, avionics, navigation systems shape the architecture and automatic control of aircraft provide subsystems that are part of the overall system and the relationship between them.

PCS 9. The ability to introduce achievements of domestic and foreign science and engineering, to use innovative experience in avionics

Program learning outcomes:

PLO2. Use a basic knowledge of major national, European and international regulations in the field of avionics for the purpose of continuous improvement of their professional activities.

PLO4. Apply modern technologies for automation of design and construction of information and control systems in the avionics field, be able to create hardware and software to increase the accuracy, reliability of control systems and other qualities of the aircraft

PLO5. To develop technical tasks for designing control systems of aircraft and means of technological equipment, to choose equipment and technological equipment.

PLO7. Analyze and create the architecture of Automatic Control aircraft provide subsystems and objects that are part of the system and the interconnections between them.

PLO8. To determine the structure and parameters of the test equipment to conduct experiments to determine the characteristics of the instruments and control systems aircraft, pas rametriv their components and products.

PLO14. Use modern information and communication technology in avionics.

Interdisciplinary Relations:

Prerequisites for studying this discipline: Mathematical foundations of digital systems: algorithmic control processes; automation of information and control processes.

The course supports the following courses: Digital control systems, Microcontrollers in control systems.

3. Content of the course

Module 1

Substantial Module 1. General functions and principles of computer networks construction.

Topic 1. General characteristics of network computing and computer technologies. The need for computing technologies. The need for telecommunication technologies. Batch data processing. Multi-terminal systems. The emergence and evolution of computer networks. Convergence of computer information networks and prospects for their development.

Topic 2. Basic principles of computer networks construction.

A simpler network model with two computers. Consistent resources usage. Data exchange. Peripherals. Network operating system. Topology. Routing. Information flows.

Topic 3. Architecture and standardization of computer networks.

Task's decomposition of network interaction. Protocol and protocol stack. General characters model interface OSI. Networks Standardization. Examples of computer networks.

Topic 4. General characteristics of the computer network.

Main network requirements. Subjective quality assessments of the network. Statistical quality assessments. Delayed packets. Data rate. Fault tolerance, scaling, compatibility.

Substantial Module 2. Technologies of computer networks on the physical level.

Topic 5. Physical characteristics of communication channels.

Physical medium of signals transmission. Primary lines and communication channels. Data transmission equipment. Spectral signals analysis. Bandwidth.

Topic 6. Operational characteristics of communication lines.

Wave resistance and attenuation. Immunity and reliability. Bits and bytes. Cables types.Screening.Structured cable systems.

Topic 7. Signal modulation and data coding methods.

Types and modulation methods. Analog signals modulation. Sampling. Discrete signals modulation. Coding. Choosing a coding method. Codes types. Potential code. Bipolar encoding. Pulse code. Manchester code. Redundant code.

Topic 8. Methods of data multiplexing.

Scrambling and data compression. Errors detection and errors correction. Multiplexing and Switching. FDM and WDM methods. Channel mode.

Substantial Module 3. Technologies of Wireless Computer Networks.

Topic 9. Principles of wireless data transmission.

The needs and benefits of wireless networks. Physical bases of wireless transmission. Electromagnetic waves and interactions. Radio bands. Radio frequency. Resource and licensing.

Topic 10. Technologies of wireless data transmission.

Two-point and multi-point communication. Geostationary satellite systems. Other satellite systems. Spectrum expansion.Code access distribution.

Topic 11. Examples of wireless computer networks.

IrDA Networks. Bluetooht Networks. Wifi Networks. WiMax Networks. Cellular networks.

Substantial Module 4. Typical architectures of computer networks.

Topic 12. Logical structuring and switching of local networks.

A typical topology. LAN protocols standardization. Ethernet technology. MAC addresses. Ethernet frame formats. Ethernet performance. Token Ring technologies. Non-wired 802.11 standard networks. Personal Network technology. Bluetooth architecture. Bridges and switches. Network logical structure. Topological limitations in local area networks. High speed versions of Fast Ethernet and Gigabit Ethernet networks. Intelligent switch functions.

Topic 13. Addressing and routing in the TCP/IP network.

Stacktext protocols TCP/IP. Types of TCP/IP stack addresses. Local addresses. Network IP addresses. IP addresses classes. Special IP addresses. Application of masks at IP addressing. The order of assigning IP addresses. Assign offline network addresses. Protocol of addresses permission. Proxy protocol. DNS system. DNS schema. DHCP protocol. Dynamic addressing algorithm. IP packet format. IP routing scheme. Packages fragmentation.

4. Course structure

Subjects	Auditorium hours				
	full-time				
	total	among them			
		lectures	practice works	lab works	self-prepar
1	**2**	**3**	**4**	**5**	**6**
Module 1					
Substantial Module 1 – General functions and principles of computer networks					

construction					
Topic 1. General characteristics of network computing and computer technologies	4	2	–	–	2
Topic 2. Basic principles of computer networks construction	14	2	–	8	4
Topic 3. Architecture and standardization of computer networks	14	2	-	8	4
Topic 4. General characteristics of the computer network	5	2	–	–	3
Control module 1	1	–	–	–	1
Total for Substantial Module 1	38	8	-	16	14
Substantial Module 2 – Technologies of computer networks on the physical level					
Topic 5. Physical characteristics of communication channels	8	4	–	–	4
Topic 6. Operational characteristics of communication lines	17	4	-	8	5
Topic 7. Signal modulation and data coding methods	6	2	–	–	4
Topic 8. Methods of data multiplexing	7	2	–	–	5
Control module 2	1	–	–	–	1
Total for Substantial Module 2	39	12	-	8	19
Substantial Module 3 – Technologies of Wireless Computer Networks					
Topic 9. Principles of wireless data transmission	8	2	-	–	6
Topic 10. Technologies of wireless data transmission	10	4	–	–	6
Topic 11. Examples of wireless computer networks	17	2	–	8	7
Control module 3	1	–	–	–	1
Total for Substantial Module 3	36	8	-	8	20
Substantial Module 4 – Typical architectures of computer networks					
Topic 12. Logical structuring and switching of local networks	11	2	–	–	9
Topic 13. Addressing and routing in the TCP/IP network	10	2	-	–	8
Control module 4	1	–	–	–	1
Total for Substantial Module 4	22	4	-	–	18
Total	**135**	**32**	**-**	**32**	**71**

5. Topics of seminar classes

№ a/o	Topic name	Hours
1	Not appointed	–

6. Topics of lab classes

№ a/o	Topic name	Hours
1	Studing the NetCracker Pro package. Construction of the simplest Local Area Network	8
2	Basic principles of computer networks construction. Architecture and standardization of computer networks.	8
3	Construction of the Local Area Network using Ethernet technology. Methods of access in Local Area Networks	8
4	Construction of Local Area Networks using Token Ring and FDDI technologies	8
Total hours		**32**

7. Topics of tutorial classes

No. a/o	Topic name	Hours
1	Not appointed	

8. Self-preparation

№ a/o	Topic name	Hours
1	General characteristics of network computing and computer technologies.	2
2	Basic principles of computer networks construction.	4
3	Architecture and standardization of computer networks.	4
4	General characteristics of the computer network.	3
5	Physical characteristics of communication channels.	4
6	Operational characteristics of communication lines.	5
7	Signal modulation and data coding methods.	4
8	Methods of data multiplexing.	5
9	Principles of wireless data transmission	6
10	Technologies of wireless data transmission	6
11	Examples of wireless computer networks	7
12	Logical structuring and switching of local networks	9
13	Addressing and routing in the TCP/IP network	8
14	Module control	4
Total hours		**71**

9. Individual assignments

№ a/o	Topic name	Hours
1	Not appointed	–

10. Teaching methods

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

11. Modes of Assessment

The planned modes of assessment include lab report submission, defense of individual assignments in correspondence with substantial modules and topics, final examination.

12. Assignment of grade points obtaining by a student (credit passed)

12.1. Points distribution that students receive

Semester 6

Components of educational work	Marks per lesson (task)	Number of lessons (tasks)	Total marks
Substantial Module 1			
Work on lectures	0…2	4	0…8
Execution and submit of laboratory works	0…10	1	0…12
Module 1	0…5	1	0…5
Substantial Module 2			
Work on lectures	0…2	6	0…12
Execution and submit of laboratory works	0…10	1	0…12
Execution and submit of practice works	-	-	-
Module 2	0…5	1	0…5
Substantial Module 3			
Work on lectures	0…2	4	0…8
Execution and submit of laboratory works	0…10	1	0…12
Execution and submit of practice works	-	-	-
Modulel 3	0…5	1	0…5
Substantial Module 4			
Work on lectures	0…2	2	0…4
Execution and submit of laboratory works	0…10	1	0…12
Execution and submit of practice works	-	-	-
Module 4	5	1	0…5
Total for the semester			**0…100**

Semester control (exam/pass) is carried out in case of student refusal from the marks of the current testing and in the presence of admission to the exam/pass. During the semester exam/pass the student has the opportunity to receive a maximum of 100 marks.

The ticket for the exam/pass consists of one theoretical question (30 points), one practical question (30 points) and one laboratory task that must be completed on a computer (40 points).

12.2. Qualitative assessment criteria

Knowledge required for good mark: design the architecture of a computer network of a given level, configuration and maintenance network equipment and services, using the network technologies in control tasks, basic level of network security provision.

Required skills for good mark: have practical skills in modern and perspective directions of development and convergence of telecommunication networks and services, directions of development of potential information threats.

12.3. Evaluating criteria of the student work during the semester

1. Excellent (90 ÷ 100 points):

1.1 Student knows the basic concepts and principles pertaining to the discipline "Electrical Engineering". Student has defended all practical, laboratory and individual tasks, completed all modular tasks with an "excellent" mark, has excellent practical skills in circuit design. Freely uses the educational and scientific literature on the discipline subject. Student can logically and clearly form his answer, solve practical and laboratory tasks. An excellent performance, clearly outstanding. Student demonstrates excellent judgement and a very high degree of independent thinking.

1.2 A reduction in the number of the mark points is possible with inaccurate wording in the answers to the additional questions posed to student.

2. Good (75 ÷ 89 points):

2.1 Student has sufficient knowledge of the theoretical part of the discipline. Defended all practical, laboratory and individual tasks, completed all modular tasks with a "good" mark, has practical skills in circuit design. Correctly solves practical tasks, student's answers are not clear. A good performance in most areas. Student demonstrates a reasonable degree of judgement and independent thinking in the most important areas.

2.2 A reduction in the number of the mark points is possible if the theoretical or practical questions are not fully answered.

3. Satisfactory (60 ÷ 74 points):

3.1 Student has weak theoretical knowledge, has a minimum of knowledge and skills, makes mistakes in solving practical problems. Has defended all practical, laboratory and individual tasks, completed all modular tasks, has unsure practical skills in circuit design. A satisfactory performance, but with significant shortcomings. Student demonstrates a limited degree of judgement and independent thinking.

3.2 A reduction in the number of the mark points is possible due to inaccurate and incomplete answers to theoretical and practical questions.

Grading scale: national

Total marks	National validation grade	
	Exam	Pass
90 – 100	excellent	pass
75 – 89	good	
60 – 74	satisfactory	
0 – 59	unsatisfactory	no pass

13. Methodical support

1. Electronic abstracts of lectures.
2. Summary notes of lectures.
3. Methodical instructions for laboratory work.
4. Topics for self-study (unaided) work.
5. Checklist.

https://drive.google.com/drive/u/0/folders/1AfOqHiGqokXgSMjcBEtleGOWfT1ZrYmC

14. Recommended reading

Basic sources

1. Losev Yu. I., Rukkas K. M., Shmatkov S.I. Computer Networks. Tutorial . - Kh.: KhNU, 2013

2. Olifer VG, Olifer N.A. Computer networks. Principles, technologies, protocols: Textbook for high schools. 4th ed. - St. Petersburg: Peter, 2011.

3. Minuhin S. V., Kavun S. V., Znhur S. V. Computer networks. General principles of functioning of computer networks. Tutorial. - Kharkiv: KhNEU, 2008.

4. Azarov O. D., Zakharchenko SM, Kaduk O. V., Orlova M. M., Tarasenko V. P. Computer networks. A manual for the MONU. - VNTU, 2013.

5. Werner M. Basics of coding. A textbook for high schools. - M: Technosphere, 2004

6. Zhukov I.A., Drovozov V.I., Maslovsky B.G. Operation of computer systems and computers, dir: Teaching manual. - K: NAU. 2007.

Complementary reading

1. Maksimov N. V., Partika T. I., Popov I. I. Computer Architecture and Computing Systems, the walls Textbook - M.: Infra-M, Forum, 2013

2. Abramov V. O. Architecture of electronic computing machines. Tutorial. - K .: KMPU, 2007

3. Stepanov A. M. Architecture of computing systems and computer networks. Textbook for Higher Educational Institutions.- St. Petersburg: Peter, 2007.

4. Kavun S. V., Sorbat I. V. Computer Architecture. Features of using computers in IP. Tutorial.- Kh:KNEU, 2010

15. Information resources

1. Site of department 301: k301.info.