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

WORK PROGRAM OF THE COMPULSORY DISCIPLINE

Electrial Engineering
(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
(code number and the name of specialization)

Form of study: full-time

Level of Qualification: 1st (bachelor degree)

Kharkiv 2020

Study program of compulsory discipline "Electrical Engineering" is for English-speaking students of training direction 173 "Avionics".

«____» _____ 2020, 10 p.

Developer: Zymovin A. Ya., Professor of dep. 301, Candidate of Science (Engineering) _____ (sign)

Kosterna O. Yu., assistant of dep. 301 _____ (sign)

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

Record of proceeding: No. "1" from «29» 08 2020

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, 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 rowspan="2">Calendar year:</td></tr>
<tr><td>Substantial modules – 2</td></tr>
<tr><td rowspan="3">Individual Assignment:
1. “Computing the solution for complex DC circuit using the basic methods”</td><td rowspan="3">Program Subject Area
173 “Avionics”</td><td>2020/2021</td></tr>
<tr><td>Semester</td></tr>
<tr><td>3</td></tr>
<tr><td rowspan="2">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>32</td></tr>
<tr><td rowspan="4">Academic hours per week for full-time study:
classroom – 4,
self-preparation – 4.5.</td><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 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 – arming students with basic ways of the direct and alternating current application in various engineering areas, to equip them with knowledge and experience necessary for successful completion of Electrical Engineering course.

Learning Objectives – providing for the knowing how to apply fundamental laws and techniques that govern the behavior and analysis of electric circuits.

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

GC1. Ability to abstract thinking, analysis and synthesis.
GC 2. Ability to apply knowledge in practical situations.
GC 3. Ability to communicate in a foreign language.
GC 5. Ability to learn and master a modern knowledge.
GC 6. Ability to search, process and analyze information from various sources.

PCS2. The ability to use science and technology in the profession, to argue the choice of methods for specialized tasks of analysis and synthesis systems of avionics systems.

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 7. The ability to determine the composition of the testing equipment necessary for experiments to determine the characteristics and parameters and control system aircraft.

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

Program learning outcomes:

PLO1. Use different forms of representation of avionics systems and describe their different methods (verbal, graphic, formally), analyze situations that may occur during their operation

PLO3. Use science and technology in the professional activity, to argue the choice of methods for solving specialized tasks of analysis and synthesis of avionics

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

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. Preserve and increase moral, cultural, scientific achievements and values of society by understanding the history and patterns of development of this

domain, its place in the overall system knowledge and the development of society, techniques and technologies, use different types and forms of healthy living

Interdisciplinary Relations:

Prerequisites for studying this discipline:

Higher mathematics: calculating the systems of equations, functions research and plotting the graphs construction; vector algebra. Physics: Electric current, voltage, etc.

The course supports the following courses:

Electronics. Microcontrollers in Control Systems. Automatic Control Theory.

3. Content of the course

Module 1. Electrical Engineering Fundamentals

Substantial Module 1. Resistive networks analysis

Topic 1. Fundamentals of electrical circuits

Brief history of electrical engineering development. Subject of study and task of the discipline. Valuable advantages of electrical energy. Basic elements of electric circuits. Analysis of direct current (DC) circuits.

Topic 2. Variety of electric elements and circuit connections

Ohm's law and Kirchhoff's laws. Serial and parallel connections. The conversion of delta-connected resistances into an equivalent wye connection and vice versa.

Topic 3. Electric energy sources

Circuit symbol of electric energy sources. Voltage source and current source (ideal and real). Equivalent sources. Serial sources connection. Parallel sources connection. Electric energy and power. Work and power of electric current.

Topic 4. Fundamental laws and investigation methods of electrical engineering

Usage of Kirchhoff's laws for calculating complex circuits. Node-voltage and loop-current calculation techniques. Methods of superposition and equivalent generator.

Substantial Module 2. AC networks analysis

Topic 5. Sinusoidal currents and voltages

Computing currents, voltages, and energy stored in capacitors and inductors. AC circuits with a capacitor or inductor and resistor; concept of impedance. Derivation of differential equation(s) for circuits containing inductors and capacitors.

Topic 6. AC variables presentation in the domain of complex variables

Conversion of time-domain sinusoidal voltages and currents to vector (phasor) notation. Representation of circuits using a reactance and impedances. Approaches of DC circuit analysis methods to AC circuits in phasor form; frequency-domain analysis.

Topic 7. Calculation of typical AC circuits containing reactive elements

Features of behavior of simple AC circuits containing a resistor and a capacitor, a resistor and an inductor (first-order connecting links).

Topic 8. Frequency response and appropriate systems analysis

The concept and the physical significance of frequency domain analysis. Computing the frequency response of circuits using AC circuit analysis tools. Analysis of simple first order electrical filters, their frequency response and filtering properties. Graphical representation of the frequency response in form of Bode plot.

Topic 9. Resonance in electrical circuits

Second-order circuits. Voltage and current resonance. Quality factor of the resonant circuit.

4. Course structure

Subjects	Auditorium hours				
	full-time				
	total	among them			
		lectures	tutor classes	lab works	self-prepar
1	**2**	**3**	**4**	**5**	**6**
Module 1 – Electrical Engineering Fundamentals					
Substantial Module 1 – Resistive networks analysis					
Topic 1. Electrical circuit basics	11	2	–	4	5
Topic 2. Variety of electric elements and circuit connections	13	4	–	4	5
Topic 3. Electric energy sources	12	4	–	–	7
Topic 4. Fundamental laws and investigation methods of electrical engineering	21	6	–	8	8
Control module 1	5	-	-	-	5
Total for Substantial Module 1	62	16	–	16	30
Substantial Module 2 – AC networks analysis					
Topic 5. Sinusoidal currents and Voltages	7	2	–	–	5
Topic 6. AC variables presentation in the domain of complex variables	10	4	–	–	6
Topic 7. Calculation of typical AC circuits containing reactive elements	20	4	–	8	8
Topic 8. Frequency response and appropriate systems analysis	10	2	–	–	8

Topic 9. Resonance in electric circuits	21	4	–	8	9
Control module 2	5	-	-	-	5
Total for Substantial Module 2	73	16	–	16	41
Module 1 Total	**135**	**32**	**–**	**32**	**71**

5. Topics of seminar classes

No. a/o	Topic name	Hours
1	Not appointed	

6. Topics of lab classes

Module 1

No. a/o	Topic name	Hours
1	Acquaintance with the EE Lab. Work place organization, component parts, instruments. Intro to PC simulation program EWB.	4
2	Investigating linear DC circuits composed of serial, parallel, and mixed resistor connections.	4
3	Ohm's law verification in a DC circuit energized by a single source.	4
4	Measurement and verification of loop currents and node voltages in a complex DC circuit.	4
5	Investigation of impedance in AC circuits. Testing of Ohm's law generalization.	8
6	Voltage resonance phenomena research.	4
7	Current resonance phenomena research.	4
	Total	**32**

7. Topics of tutorial classes

No. a/o	Topic name	Hours
1	Not appointed	

8. Self-preparation

No a/o	Topic name	Hours
1	Basics of electric elements and circuit; fundamental methods for electric circuits analysis and calculation	41
2	Special approaches for AC circuit examination and calculation	30
	Total	**71**

9. Individual assignments

"Computing the solution for complex DC circuit using the basic methods"

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 passing.

12. Assessment criteria and points distribution that students receive

12.1. Points distribution that students receive

3 semester

Components of educational work	Marks per lesson (task)	Number of lessons (tasks)	Total marks
Substantial Module 1			
Lectures work	0…1	8	0…8
Execution and protection of laboratory works	0...4	8	0...32
Execution and protection of practical works	-	-	-
Module 1	0…5	1	0…5
Substantial Module 2			
Lectures work	0…1	8	0…8
Execution and protection of laboratory works	0...4	8	0...32
Execution and protection of practical works	-	-	-
Module 2	0…5	1	0…5
Performance and protection of individual assignments	0…10	1	0…10
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 evaluation criteria

Knowledge required for good mark: knowledge in electrical signals and sufficient skills in the Electronic Workbench, which provides great opportunities for electrical circuits.

Required skills for good mark: to be able to use: methods for analyzing and calculating the electrical circuits. To be able to handle with: equipment and measuring instruments used in laboratory and practical work; breadboards; Electronic Workbench program.

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. Summary of lectures on discipline "Electrical Engineering".
2. Instructions and assignment for laboratory course.
3. Educational Methodical Complex of Discipline in electronically hosted on the server of the dep. 301.

https://drive.google.com/drive/u/0/folders/1AZxeeG8SQmo2Oara3PgzO-QCjPvpTCQX

14. Recommended references

Basic sources

1. Theraja B. L. A textbook of Electrical Technology [Text] / B. L. Theraja, A. K. Theraja, Volume 1. Basic Electrical Engineering, New Delhi, 2004. – 800 p.
2. Jimmy J. Cathey. Basic Electrical Engineering [Text] / Jimmy J. Cathey, Syed A. Najar. Mc. Graw Hill, 1997. – 335 p.
3. Kasatkin A. Basic Electrical Engineering [Text] / A. Kasatkin / Moskow, Mir., 1976. – 479 p.

Complementary references

1. Rajlnder Kumar Dhawan. Hand Book of Electrical Engineering [Text] / Rajlnder Kumar Dhawan. – Delhi, 2004. – 711 p.
2. Zimovin A. Ya. Basic Electrical Engineering [Text] / A.Ya. Zimovin, V.N. Postnikov, L.I. Volchanskaya. – Kharkiv: National Aerospace university "KhAI", Part 1, 2008. – 106 p.
3. Zimovin A. Ya. Basic Electrical Engineering [Text] / A.Ya. Zimovin, V.N. Postnikov, L.I. Volchanskaya. - Kharkiv: National Aerospace university "KhAI", Part 2, 2011 – 116 p.
4. Irving Kosov. Electric Machinery and Transformers Pearson Education [Text] / Irving Kosov. Inc. New Delhi, 1991. – 626 p.

15. Information resources

Department's site: k301info.