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
«____» _____ 2020

WORK PROGRAM OF THE COMPULSORY DISCIPLINE

Automatic Control Theory
(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

The developed study program of compulsory discipline «Processes Control in Condition of Uncertainty» is for English-speaking students of training direction 173 – Avionics

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Developers: Pasichnyk S. N., associate professor of department 301, Candidate of Science (Engineering)

(sign)

Sokol D. V., assistant of department 301

(sign)

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

Record of proceeding: № 1 from " 29 " 08 2020

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

1. Course description

<table>
<tr><td rowspan="2">Indices</td><td rowspan="2">Branch of education, learning direction, education level</td><td colspan="3">Full-time study</td></tr>
<tr><td colspan="3">Compulsory discipline</td></tr>
<tr><td>ECTS credits – 15</td><td rowspan="15">Field of Study
17 – Electronics and Telecommunication

Program Subject Area
173–Avionics

Educational Program
Systems of Autonomous Navigation and Adaptive Control of Aircrafts

Education Level:
1st (bachelor degree)</td><td colspan="3">Calendar year</td></tr>
<tr><td>Modules – 11</td><td colspan="2">2020-2021</td><td>2021-2022</td></tr>
<tr><td>Semantic modules – 11</td><td colspan="3">Semester</td></tr>
<tr><td>Research into the topic
_____
(topic name)</td><td>5-й</td><td>6-й</td><td>7-й</td></tr>
<tr><td>Total hours – 192 / 450</td><td colspan="3">Lectures [1)]</td></tr>
<tr><td>Academic hours per day for full-time study</td><td>32 hrs.</td><td>32 hrs.</td><td>–</td></tr>
<tr><td>Semester 5</td><td colspan="3">Practice classes [1)]</td></tr>
<tr><td>Classroom – 6 hrs.
Self-study – 7,2 hrs.</td><td>32 hrs.</td><td>16 hrs.</td><td>16 hrs.</td></tr>
<tr><td>Semester 6</td><td colspan="3">Lab classes [1)]</td></tr>
<tr><td>Classroom – 5 hrs.
Self-study – 6,3 hrs.</td><td>32 hrs.</td><td>32 hrs.</td><td>–</td></tr>
<tr><td>Semester 7</td><td colspan="3">Self-study (unaided) work</td></tr>
<tr><td rowspan="2">Classroom – 1 hrs.
Self-study – 2,8 hrs.</td><td>114 hrs.</td><td>100 hrs.</td><td>44 hrs.</td></tr>
<tr><td colspan="3">Assessment form</td></tr>
<tr><td></td><td></td><td>Final examination</td><td>Final examination</td><td>Differentiated pass</td></tr>
</table>

[1)] depending on timetable, classroom studies can decrease or enlarge by one hour in a week

Note: ratio of classroom working and unaided (self-study) work makes:
192/258 (under full-time education).

2. Purpose and objectives of academic discipline

Learning Aims is study of the main provisions, theoretical foundations for the development of modern automatic control systems; modern principles, schemes and methods of construction of control systems, their characteristics.

Training objectives - obtaining the skills of forming the structure of the system of automatic control, developing functional and structural schemes, constructing mathematical models of functional elements, solving problems of analysis and synthesis of the system, experimental study of functional properties of the system.

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

GC1. Ability to abstract thinking, analysis and synthesis.
GC2. Ability to apply knowledge in practical situations.
GC3. Ability to communicate in a foreign language.
GC5. Ability to learn and master modern knowledge.
GC6. Ability to search, process and analyze information from various sources.
GC7. Ability to generate new ideas (creativity).
GC8. Ability to make informed decisions.
GC9. Ability to work in a team.
GC11. Ability to work autonomously.
FC2. Ability to use the achievements of science and technology in professional activities, to justify the choice of methods for solving specialized problems in the analysis and synthesis of automation systems.
FC3. Ability to implement and use hardware and software-algorithmic tools to increase the accuracy and reliability of control systems.
FC9. Ability to implement the achievements of domestic and foreign science and technology, to use innovative experience in the field of automation.
Program learning outcomes:
PLO3. Use the achievements of science and technology in professional activities, justify the choice of methods for solving specialized problems in the analysis and synthesis of automation systems with mobile devices.
PLO4. Apply modern automation technologies for the design and construction of information and control systems in the field of automation, be able to create hardware and software to increase the accuracy, reliability of control systems with mobile applications.
PLO14. Preserve and increase moral, cultural, scientific values and achievements of society based on understanding the history and patterns of development of this subject area, its place in the general knowledge system and in the development of society, equipment and technology, use different types and forms of healthy living.

Interdisciplinary connections:

Prerequisites for studying this discipline: Higher Mathematics: Differential and

Integral Computing; actions with complex numbers in the algebraic and expressive form; researching functions and constructing their schedules; vector algebra. Fundamentals of CS modeling: approaches to the mathematical modeling of objects, the formation of the mathematical description of ACO, Actuator, etc.

Knowledge obtained during the study of this discipline is used in the following disciplines: Control System Designing, Digital control systems. Aircraft control systems. Modern theory of automatic control. During course and diploma work.

3. Content of the course (Course syllabus)

Module 1. Stabilization of physical quantities

Semantic Modulus 1. Stabilization of physical quantities

Topic 1. Admission to the course "Automatic Control Theory".

Stabilization of physical quantities.

Topic 2. Choice of executive bodies.

Characteristics of engines of series SL. Methods of calculating the required power of the engine.

Module 2. Functional properties SAS (system of automatic stabilization)

Semantic Modulus 2. Functional properties of SAS

Topic 3. Models of electric motors of series SL.

Supervised model. Graphic model. Mathematical model. The transfer function of the engine control action. The transfer function of engine perturbations.

Topic 4. Use of the principle of control for reference action for solving the stabilization problem.

Functional diagram ACO. ACO block diagram. Formation of the structure of the automatic stabilization device. SAS Characteristics. Quality parameters SAS.

Topic 5. Stability.

Methods for assessing the stability of SAS. Lyapunov method. Nyquist method. Hurwitz method.

Topic 6. Controllability. Observability.

Description of SAS in the state of space. Variables will state. Matrix of controllability. Observability matrix.

Module 3. Invariance SAS

Semantic Modulus 3. Invariance SAS

Topic 7. Use of the principle of control for disturbance for solving the stabilization problem.

Functional diagram ACO. ACO block diagram. Formation of the structure of the automatic stabilization device. SAS Characteristics. Invariance system for disturbances.

Topic 8. Experimental determination of parameters of transfer functions ACO.

Linearization of nonlinear characteristics. Determination of the transfer factor of SAS elements by static characteristics. Determination of the time constant for transient characteristics.

Determine the transmission factor of SAS elements and the time constant for frequency characteristics.

Module 4. Close-loop SAS

Semantic Modulus 4. Close-loop SAS.

Topic 9. Use of the principle of control over deviations to solve the problem of stabilization.

Functional diagram ACO. ACO block diagram. Formation of the structure of the automatic stabilization device. Characteristics of closed SAS. Quality parameters SAS.

Topic 10. Frequency response.

Frequency Response Types. Experimental and calculated amplification of amplitude-frequency, phase, amplitude-phase and logarithmic characteristics. Determination of SAS quality parameters with frequency characteristics. Bandwidth Cutoff Frequency.

Module 5. Correction of continuous and digital SAS

Semantic Modulus 5. Correction of continuous and digital SAS

Topic 11. Methods of synthesis of SAS.

Adjustment device. Serial, parallel adjusting devices and corrective feedback. Method of synthesis by logarithmic frequency characteristics. The method of the root locus.

Topic 12. Digital SAS.

Quantization on time. Quantization on the level. Select a quantization period. Z-transformation. Pulse transfer functions of SAS. Characteristics of digital SAS.

Module 6. Positioning of physical quantities

Semantic Modulus 6. Positioning of physical quantities

Topic 13. Positioning of physical quantities.

The task of positioning. Automatic Positioning Object (APO). Automatic positioning device (APD). Functional scheme of the object of automatic positioning. Functional scheme of the automatic positioning device.

Topic 14. Use of the principle of control over reference action for solving the positioning problem.

Principle of management by defining influence. Functional scheme of the automatic positioning system (APS). Space will be. Variables will state. Description of APO in state space. APO block diagram.

Module 7. Invariance APS

Semantic Modulus 7. Invariance APS

Topic 15. Using the principle of control for disturbance to solve the problem of positioning.

The principle of control disturbance. Functional scheme of the object of automatic positioning. Functional diagram of the automatic positioning device. APO block diagram. APD block diagram. Typical OAP features. Invariance. Transmission Transfer function of the correction element.

Topic 16. Analysis of the functional properties of the object of automatic positioning.

APO controllability. Observability APO. Stability APO The first method of Lyapunov.

Module 8. Close-loop APS

Semantic Modulus 8. Close-loop APS

Topic 17. Use of the principle of control over deviations for solving the positioning problem.

Principle of control for deviation. Functional diagram of closed APS. Feedback. Block diagram of closed APS. Transfer functions of closed APS. Characteristics of a closed APS. Quality Score.

Topic 18. Correction elements.

Closed APS precision. High-speed error. Serial, parallel adjusting devices and corrective feedback. APS synthesis method based on logarithmic frequency characteristics.

Module 9. Correction of continuous and digital APS

Semantic Modulus 9. Correction of continuous and digital APS

Topic 19. Methods of synthesis SAP.

Adjustment device. Serial, parallel adjusting devices and corrective feedback. APS synthesis method based on logarithmic frequency characteristics. The method of the root hodograph. Modal control.

Topic 20. Digital APS.

Quantization on time. Quantization on the level. Select a quantization period. Z-transformation. Pulse transfer functions of APS. Features of digital APS.

Module 10. Nonlinear systems

Semantic Modulus 10. Nonlinear systems

Topic 21. Non-linear APS. Elementary nonlinearities.

Static characteristics of the simplest nonlinear elements. The method of harmonic linearization of nonlinearities. The coefficients of harmonic linearization. Characteristics of harmonically linearized nonlinear elements.

Topic 22. Areas of stability. Conditions of self-oscillation.

APS Transmission Limit. Amplitude of self-oscillations. Frequency of self-oscillations. Dependence of the stability of the nonlinear APS on the amplitude of the input signal.

Module 11. Course Project

Semantic Modulus 11. Course Project

Topic 23. Synthesis of automatic system working mechanism.

Completing the tasks of the course project (see the topic of practical classes).

4. Course structure

Semantic modules and topics	Hours full-time				
	total	Among them			
		lec	pr	lab	s.l.
1	2	3	4	5	6
Module 1					
Semantic Modulus 1. Stabilization of physical quantities					
Topic 1. Admission to the course "Automatic Control Theory".	5	2	–	–	3
Topic 2. Choice of executive bodies.	10	2	2	–	6
Modulus control	1	-	-	-	1
Total for semantic modulus 1	16	4	2	–	10
Module 2					
Semantic Modulus 2. Functional properties of SAS					
Topic 3. Models of electric motors of series SL.	12	2	2	–	8
Topic 4. Use of the principle of control for reference action for solving the stabilization problem.	18	2	2	4	10
Topic 5. Stability.	20	4	4	2	10
Topic 6. Controllability. Observability.	14	2	2	2	8
Modulus control	1	-	-	-	1
Total for semantic modulus 2	65	10	10	8	37
Module 3					
Semantic Modulus 3. Invariance SAS					
Topic 7. Use of the principle of control for disturbance for solving the stabilization problem.	16	2	2	4	8
Topic 8. Experimental determination of parameters of transfer functions ACO.	16	2	2	4	8
Modulus control	1	-	-	-	1
Total for semantic modulus 3	33	4	4	8	17
Module 4					
Semantic Modulus 4. Close-loop SAS					
Topic 9. Use of the principle of control over deviations to solve the problem of stabilization.	18	2	2	4	10
Topic 10. Frequency response.	26	4	4	4	14
Modulus control	1	-	-	-	1
Total for semantic modulus 4	45	6	6	8	25
Module 5					
Semantic Modulus 5. Correction of continuous and digital SAS					
Topic 11. Methods of synthesis SAS.	36	6	8	8	14
Topic 12. Digital SAS.	14	2	2	–	10
Modulus control	1	-	-	-	1
Total for semantic modulus 5	51	8	10	8	25
Total for semantic modulus 1-5 (Semester 5)	**210**	**32**	**32**	**32**	**114**
Module 6					
Semantic Modulus 6. Positioning of physical quantities					

Topic 13. Positioning of physical quantities .	8	2	–	–	6
Topic 14. Use of the principle of control over reference action for solving the positioning problem..	18	4	2	6	6
Modulus control	1	-	-	-	1
Total for semantic modulus 6	27	6	2	6	13
Module 7					
Semantic Modulus 7. Invariance APS					
Topic 15. Using the principle of control for disturbance to solve the problem of positioning..	16	4	2	4	6
Topic 16. Analysis of the functional properties of the object of automatic positioning.	14	2	2	2	8
Modulus control	1	-	-	-	1
Total for semantic modulus 7	31	6	4	6	15
Module 8					
Semantic Modulus 8. Close-loop APS					
Topic 17. Use of the principle of control over deviations for solving the positioning problem.	16	2	2	4	8
Topic 18. Correction elements.	20	4	2	2	12
Modulus control	1	-	-	-	1
Total for semantic modulus 8	37	6	4	6	21
Module 9					
Semantic Modulus 9. Correction of continuous and digital APS					
Topic 19. Methods of synthesis APS.	31	4	2	10	15
Topic 20. Digital APS.	14	4	-	-	10
Modulus control	1	-	-	-	1
Total for semantic modulus 9	46	8	2	10	26
Module 10					
Semantic Modulus 10. Nonlinear systems					
Topic 21. Non-linear APS. Elementary nonlinearities.	22	2	2	2	16
Topic 22. Areas of stability. Conditions of self-oscillation.	16	4	2	2	8
Modulus control	1	-	-	-	1
Total for semantic modulus 10	39	6	4	4	25
Total for semantic modulus 6-10 (Semester 6)	**180**	**32**	**16**	**32**	**100**
Module 11					
Semantic Modulus 11. Course Project					
Topic 23. Synthesis of automatic system working mechanism.	60	–	16	–	44
Total for semantic modulus 11 (Semester 7)	**60**	**–**	**16**	**–**	**44**
Course total	**450**	**64**	**64**	**64**	**258**

5. Topics of seminar classes

№ a/o	Topic name	Hours
1	Not appointed	–

6. Topics of practical works

№ a/o	Topic name	Hours
1	Graphical linearization of static characteristics of ACO.	4
2	Estimated selection of an actuator.	4
3	Convert SAS Structural Circuits.	4
4	Calculation of transient characteristics of SAS.	4
5	Calculation of frequency characteristics of SAS.	4
6	Assessment of the stability of the closed SAS.	4
7	Quality assessment of closed SAS.	4
8	Graphical linearization of static characteristics of APO.	2
9	Convert APS Block Diagrams	2
10	Calculation of time characteristics of APS.	2
11	Calculation of frequency characteristics of APS.	2
12	Validation of the stability of the closed APS.	3
13	Assessment of APO management and observation.	3
14	Validation of closed APS quality.	3
15	Synthesis of APS by logarithmic amplitude-frequency characteristics.	4
16	Investigation of the stability of nonlinear closed SAP.	3
17	Development of verbal, graphical and nonlinear mathematical models of UIA	3
18	Construction of a linearized mathematical model of UIA	3
19	Synthesis of automatic system by the method of logarithmic amplitude-frequency characteristics.	3
20	Development of the principle circuit diagram of the analog SAS model (APS).	3
	Total	64

7. Topics of laboratory works

№ a/o	Topic name	Hours
1	Experimental study of open SAS. Principle of management by defining influence.	6
2	Experimental study of open SAS. Principle of control over disturbing influence.	6
3	Experimental study of closed SAS. Principle of management for deviation.	6
4	Experimental study of frequency characteristics of open SAS.	6
5	Experimental study of closed SAS with transforming element of PID-type.	6
6	Experimental study of open APS. Principle of management by defining influence.	6
7	Experimental study of open APS. Principle of control over disturbing influence.	4
8	Experimental study of closed APS. Principle of management for deviation.	6
9	Experimental study of closed APS with transforming element of PID type.	6
10	Experimental study of closed APS with corrective feedback.	6
11	Experimental study of closed nonlinear APS.	6
	Total	64

8. Self-study (unaided) work

№ a/o	Topic name	Hours
1	Structure and tasks of the discipline "Theory of automatic control"	3
2	Selection of executive bodies (Topic 2)	6
3	Models of electric motors of series SL (Topic 3)	8

4	Use of the principle of control for the reference action for solving the stabilization problem. (Topic 4)	10
5	Stability (Topic 5)	10
6	Controllability. Observability. (Topic 6)	8
7	Using the principle of perturbation control for solving the stabilization problem (Topic 7)	8
8	Experimental determination of parameters of transfer functions ACO (Topic 8)	8
9	Use of the principle of control over deviations for solving the stabilization problem (Topic 9)	10
10	Frequency response (Topic 10)	14
11	Methods of synthesis SAS (Topic 11)	14
12	Digital SAS (Topic 12)	10
13	Modulus control	5
14	Positioning of physical quantities (Topic 13)	6
15	Use of the principle of control over the reference action for solving the positioning problem. (Topic 14)	6
16	Using the principle of control for disturbance to solve the problem of positioning. (Topic 15)	6
17	Analysis of the functional properties of the object of automatic positioning (Topic 16)	8
18	Use of the principle of control over deviations for solving the positioning problem. (Topic 17)	8
19	Correction elements (Topic 18)	12
20	Methods of synthesis of APS (Topic 19)	15
21	Digital APS (Topic 20)	10
22	Non-linear APS. Elementary nonlinearities (Topic 21)	16
23	Areas of stability. Conditions of self-oscillation (Topic 22)	8
24	Modulus control	5
25	Synthesis of automatic system working mechanism.	44
	Total	258

9. Individual tasks

№ a/o	Topic name	Hours
1	Not appointed	–

10. Teaching methods

Lectures delivering, conducting lab classes, individual consultations (if necessary), independent work of students with tutorials issued by the department (learning the manuals).

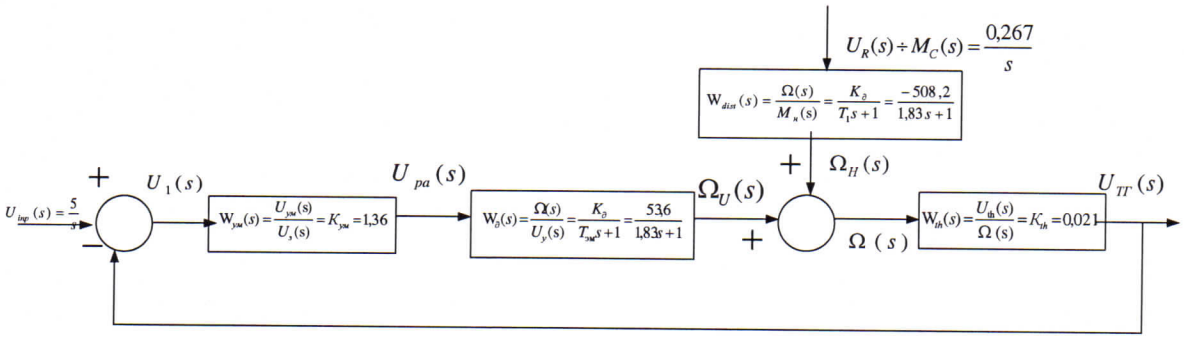
11. Forms of control

Current control tests in form of lab report submission, defense of individual assignments corresponding to semantic modules and topics, final examination.

12. Assignment of grade points obtaining by a student (final examination, differential pass)

The examination card consists of 3 question: theory, practice problem and bench-oriented question. For example:

1. Main tasks of Automatic Control Theory.
2. Algorithm for obtain correction element.
3. Quality parameters of System Automatic Stabilization.
4. Build step response for reference.



5. Build static characteristic of open-loop stabilization system

12.1. Student's grades for each type of work

5 semester

Components of educational work	Grades per class (task)	Classes (tasks) amount	Total grade
Semantic modulus 1			
Work on lectures	0…0	4	0…0
Execution and submitting the laboratory works	0…6	1	0…6
Execution and submitting the practical works	0…5	1	0…5
Modulus control	0…5	1	0…5
Semantic modulus 2			
Work on lectures	0…0	4	0…0
Execution and submitting the laboratory works	0…6	1	0…6
Execution and submitting the practical works	0…5	1	0…5
Modulus control	0…5	1	0…5
Semantic modulus 3			
Work on lectures	0…0	2	0…0
Execution and submitting the laboratory works	0…6	1	0…6

Execution and submitting the practical works	0…5	1	0…5
Modulus control	0…5	1	0…5
Semantic modulus 4			
Work on lectures	0…0	4	0…0
Execution and submitting the laboratory works	0…6	1	0…6
Execution and submitting the practical works	0…5	1	0…5
Modulus control	0…7	1	0…7
Semantic modulus 5			
Work on lectures	0…0	2	0…0
Execution and submitting the laboratory works	0…6	1	0…6
Execution and submitting the practical works	0…5	2	0…10
Modulus control	0…8	1	0…8
Execution and submitting the calculative work	0…10	1	0…10
Total score			**100**

6 semester

Components of educational work	Grades per class (task)	Classes (tasks) amount	Total grade
Semantic modulus 6			
Work on lectures	0…0	4	0…0
Execution and submitting the laboratory works	0…5	1	0…5
Execution and submitting the practical works	0…3	2	0…6
Modulus control	0…4	1	0…4
Semantic modulus 7			
Work on lectures	0…0	4	0…0
Execution and submitting the laboratory works	0…5	1	0…5
Execution and submitting the practical works	0…3	2	0…6
Modulus control	0…4	1	0…4
Semantic modulus 8			
Work on lectures	0…0	2	0…0
Execution and submitting the laboratory works	0…5	2	0…10
Execution and submitting the practical works	0…3	3	0…9

Modulus control	0…4	1	0…4
Semantic modulus 9			
Work on lectures	0…0	4	0…0
Execution and submitting the laboratory works	0…5	1	0...5
Execution and submitting the practical works	0…3	3	0...9
Modulus control	0…6	1	0…6
Semantic modulus 10			
Work on lectures	0…0	2	0…0
Execution and submitting the laboratory works	0…5	1	0...5
Execution and submitting the practical works	0…3	3	0...9
Modulus control	0…6	1	0…6
Execution and submitting the calculative work	0…10	1	0…10
Total score			**100**

7 semester

Components of educational work	Grades per class (task)	Classes (tasks) amount	Total grade
Semantic modulus 11			
Execution the course project	0…15	5	0…75
Defending the course project	0…25	1	0…25
Total score			**100**

12.2. Qualitative evaluation criteria

The required amount of knowledge to obtain a positive assessment:

Verbal, graphic and mathematical description of signals, elements and control systems in time and frequency domains. Estimation of stability of continuous ACS by means of algebraic and frequency methods. Estimation of quality of management of continuous ACS at the determined input actions. Solving the problem of stabilization and positioning of control objects using analytical methods. Solving the problem of stabilization and positioning of control objects using machine and semi-natural modeling of ACS

The required amount of skills to obtain a positive assessment:

Have practical skills in calculating and modeling SU elements on a computer using specialized software packages Matlab and Simulink. Be able to collect diagrams on laboratory stands and process the necessary data.

12.3. Criteria for evaluating student work during the semester

1. Excellent (90 ÷ 100 points) is given to the student:

1.1 Who knows: basic concepts and principles related to the discipline. He defended all practical, laboratory tasks and individual tasks, completed all modular tasks with a grade of "excellent", has solid practical skills in working with a laboratory stand and the Matlab package. Freely uses educational and scientific and technical literature on the subject. He can logically and clearly formulate his answer, solve practical and laboratory problems.

1.2 Reduction of the number of points within the assessment is possible with inaccurate wording in the answers to additional questions that were asked before him.

2. Good (75 ÷ 89 points) is given to the student:

2.1 Who has a deep enough knowledge of the theoretical part of the discipline. He defended all practical, laboratory tasks and individual tasks, completed all modular tasks with a grade of "good", has practical skills in working with a laboratory stand and the Matlab package. Solves practical problems correctly, his answers are not clear.

2.2 Reduction of the number of points within the assessment is possible with incomplete answers to theoretical or practical questions.

3. Satisfactory (60 ÷ 74 points) is given to the student:

3.1 Who has little theoretical material, has a minimum of knowledge and skills, makes mistakes in solving practical problems. He defended all practical, laboratory tasks and individual tasks, completed all modular tasks, has uncertain practical skills in working with a laboratory stand and the Matlab package.

3.2 Reduction of the number of points within the assessment is possible for inaccurate and incomplete answers to theoretical and practical questions.

Assessment scale: national and ECTS

<table>
<tr><td rowspan="2">Total mark</td><td colspan="2">Score on a traditional scale</td></tr>
<tr><td>Exam</td><td>Differentiated pass</td></tr>
<tr><td>90 – 100</td><td>Excellent</td><td rowspan="3">Pass</td></tr>
<tr><td>75 – 89</td><td>Good</td></tr>
<tr><td>60 -74</td><td>Satisfactory</td></tr>
<tr><td>0 – 59</td><td>Unsatisfactorily</td><td>Not pass</td></tr>
</table>

13. Methodical support

All methodical support in electronic form is placed on the server. 301
The author of all developments is the professor of the department. 301 Kulik A.S. Way to view and download: R:\materials\TAU

1. Summary of lectures on discipline "Theory of automatic control".
2. Methodical instructions and tasks for laboratory work.
3. Methodical instructions and tasks for the implementation of the course project.
4. Methodical instructions and tasks for the execution of settlement work.
5. Universal laboratory stand on the basis of analog computing machine MN-7.

Technical description.

6. System manager software. Library of service subprograms.

14. Recommended reading

Basic

1. Richard C Dorf. Robert H. Bishop, Modern Control Systems. 13th Edition, 2017.

2. Jitendra R. Raol, Ramakalyan Ayyagari, Control Systems: Classical, Modern, and AI-Based Approaches, 2019.

3. William Bolton, Instrumentation and Control Systems, 2015.

4. Shankar P. Bhattacharyya, Aniruddha Datta, Lee H. Keel, Linear Control Theory: Structure, Robustness, and Optimization, 2018.

5. Xiangjie Liu, Systems Control Theory, 2018.

6. Steven A. Frank, Control Theory Tutorial: Basic Concepts Illustrated by Software Examples, 2018.

7. Richard Bellman, Robert Kalaba, Classic Papers in Control Theory, 2017.

Complementary reading

1. Collection of problems in automatic control systems / O.G. Gordin, K.Yu. Dergachev, V.G. Dzhulgakov, etc .; under the general ed. A.S. Kulik, V.F .Simonov, 2009.

2. Makiko Nisio, Stochastic Control Theory: Dynamic Programming Principle, 2014.

3. A.K. Aziz, J.W. Wingate, M.J. Balas, Control Theory of Systems Governed by Partial Differential Equations, 2014.

15. Information resources

Department 301 website: **k301.info**.