National Technical University of Ukraine
Igor Sikorsky Kyiv Polytechnic Institute "

Department of
Electromechanical Systems
Automation and Electrical
Drives

SYNTHESIS OF LOGICAL SCHEMES

Working program of the academic discipline (Syllabus)

Details of the academic discipline	
Level of higher education	***First (undergraduate)***
Discipline	*14 "Electrical engineering"*
Specialty	*141 "Electric power engineering, electrical engineering and electromechanics"*
Educational program	*Electromechanical automation systems, electric drive and electric mobility*
Discipline status	*Mandatory*
Form of education	*Full-time (day, accelerated day)*
Year of training, semester	*First year, fall semester*
Scope of the discipline	*120 hours / 4 ECTS credits*
Semester control/ control measures	*Credit/MKR/RGR*
Class schedule	*1 lecture (2 hours) once a week;* *1 practical lesson (2 hours) once a week.*
Language of teaching	*Ukrainian*
Information about the head of the course / teachers	*Lecturer* : *Ph.D. Burian Serhiy Oleksandrovich* Practical classes: *PhD Zemlyanukhina Hanna Yuryivna*
Placement of the course	*https://do.ipo.kpi.ua/course/view.php?id=1768 (certified)*

Program of study discipline

1. Description of the educational discipline, its purpose, subject of study and learning outcomes

The syllabus of the educational discipline " Synthesis of logical circuits " is compiled in accordance with the educational program "Electromechanical systems of automation, electric drive and electromobility " (version of 2024) of bachelor's training in specialty 141 - Electric power engineering, electrical engineering and electromechanics.

The purpose of the educational discipline *there is the formation and strengthening of students' following abilities : (Z K01) Ability to abstract thinking, analysis and synthesis; (ZK03) Ability to communicate in the state language both orally and in writing; (ZK05) Ability to search, process and analyze information from various sources; (ZK06) Ability to identify, pose and solve problems; (ZK08) Ability to work autonomously ; (FK01) Ability to solve practical problems using automated design and calculation systems (CAD); (FC10) Awareness of the need to constantly expand one's own knowledge about new technologies in electric power, electrical engineering and electromechanics; (FC14) Ability to solve complex problems of logical synthesis related to the operation of discrete automation systems and microprocessor devices.*

The subject of the educational discipline *is the methods of synthesis of single-cycle and multi-cycle logic circuits, which are used to obtain a mathematical description of discrete automation systems with subsequent technical implementation based on integrated circuits.*

Program learning outcomes that the discipline aims to improve: *(PRN06) Apply application software, microcontrollers and microprocessor technology to solve practical problems in professional activities ; (PRN08) Choose and apply suitable methods for the analysis and synthesis of electromechanical and electric power systems with specified indicators; (PRN10) Find the necessary information in scientific and technical literature, databases and other sources of information, evaluate it relevance and reliability; (PRN11) Communicate freely about professional problems in national and foreign languages orally and in writing, discuss the results of professional activity with specialists and non-specialists, argue one's position on debatable issues; (PRN18) To be able to learn independently, acquire new knowledge and improve the skills of working with modern equipment, measuring equipment and application software; (PRN23) To be able to apply the laws of algebra-logic, code conversion, Carnot maps, the basis of transition tables, graph transitions , cyclograms and multiplexers -selectors for the synthesis of logic control schemes for automation systems; (PRN24) To be able to apply the methods of synthesis of discrete automation circuits to compile programs for programmable logic relays and programmable logic integrated circuits, to select equipment when designing discrete automation systems, to compile logic circuits on microcircuits using a modern element base; (PRN28) Develop design and construction documentation for control schemes of electromechanical systems; program microprocessors, microcontrollers, programmable logic integrated circuits and logic controllers and use them to implement algorithms for controlling electric drives.*

2. Pre-requisites and post-requisites of the discipline (place in the structural and logical scheme of training according to the relevant educational program)

To successfully master the discipline, the student must master the disciplines "Computer technology and programming" and "Engineering graphics". Competences, knowledge and skills acquired in the course of study are necessary for further study of the disciplines "Automation systems" and "Automation systems. Course project ".

3. Content of the academic discipline

Chapter 1 . Mathematical foundations of the synthesis of discrete circuits

Topic 1.1. Elements of algebra-logic
Topic 1.2. Axioms and laws of algebra-logic
Topic 1.3. Normal and perfect normal forms of logical functions
Topic 1.4. Functions of one and two variables
Topic 1.5. Application of Carnot maps for minimization of logical functions

Section 2 . Synthesis of single-stroke and multi-stroke circuits

Topic 2.1. Synthesis of single-cycle circuits
Topic 2.2. Designing electrical principle circuits on integrated microcircuits
Topic 2.3. Synthesis of multi-stroke circuits by the method of transition tables and Carnot maps
Topic 2.4. Synthesis of schemes with technological delays by the method of transition tables and Carnot maps
Topic 2.5. Synthesis of multi-stroke circuits by the cyclogram method
Topic 2.6. Synthesis of schemes with technological delays by the cyclogram method
Topic 2.7. Synthesis of control schemes based on a clock divider
Topic 2.8. Design of electrical principle circuits on integrated microcircuits with power equipment
Topic 2.9. Numerical systems

4. Educational materials and resources

Basic literature

1. Distance course "Synthesis of logic circuits" for bachelors of the 2nd year of the specialty 141 "Electric power engineering, electrical engineering and electromechanics", certificate NMP Series No. 6005, author-developer S.O. Buryan, - Electronic data (2.6 GB) – Kyiv: KPI named after Igor Sikorskyi, 2021, - 27.9 d. Dr. sheet Placement address: https://do.ipo.kpi.ua/course/view.php?id=1768.

2. Kovalchuk O.V. Logical synthesis of discrete automation schemes: a study guide - K.: NTUU "KPI", 2008. - 168 p. ISBN 978-966-622-294-0.

3. Synthesis of logical circuits: practicum [Electronic resource]: study guide for bachelor's degree holders in the educational program "Electromechanical systems of automation, electric drive and electric mobility " specialty 141 "Electric power, electrical engineering and electromechanics" / KPI named after Igor Sikorskyi; compiled by: S. O. Buryan, G. Yu. Zemlyanukhina . – Electronic text data (1 file: 871.73 Kbytes). – Kyiv: KPI named after Igor Sikorskyi, 2022. – 61 p. – Name from the screen (access via the link https://ela.kpi.ua/handle/123456789/48564).

4. Synthesis of logical schemes. Calculation and graphic work [Electronic resource]: study guide for students of specialty 141 "Electroenergetics, electrical engineering and electromechanics" / KPI named after Igor Sikorskyi; comp.: S.O. Weed. – Electronic text data (1 file: 8.05 MB). – Kyiv: KPI named after Igor Sikorskyi, 2019. – 80 p. (access via the link https://ela.kpi.ua/handle/123456789/38275).

5. Schemotechnika: Devices of digital electronics [Electronic resource]: in 2 volumes: a textbook for students majoring in "Electronics" / V. M. Ryabenkyi, V. Ya. Zhuykov , Yu. S. Yamnenko , A. V. Zagranichnyi ; NTUU "KPI". – Electronic text data (2 files: 5.06 MB , 5.46 MB). - Kyiv, 2016. - 757 c. – Title from the screen. (access via the link https://ela.kpi.ua/handle/123456789/18970).

6. Automation of technological processes, installations and complexes - 1 [Electronic resource]: a course of lectures for students of the training direction 6.050702 "Electromechanics" of the specialty "Electromechanical systems of automation and electric drive" full-time study / NTUU "KPI"; structure. O. V. Kovalchuk, S. O. Buryan. – Electronic text data (1 file: 26.3 MB). - Kyiv: NTUU "KPI", 2011. - Title from the screen (access via the link https://ela.kpi.ua/handle/123456789/932).

7. Senko V. I. and others. Electronics and microcircuit technology : In 4 vols. Volume 3. Digital devices: Textbook/Ed. VI Senka //K.: Caravela. - 2008.

Additional literature

8. Buryan S.O. Logical synthesis of discrete automatic control systems using programmable low-level relays / S.O. Buryan, M.V. Pechenyk , G.Yu. Zemlyanukhina , I.S. Epifantsev // Collection of Scientific Works of Admiral Makarov National Shipbuilding University. – 2021 - #1 (484). - P. 54-60 (access through the link https://doi.org/10.15589/znp2021.1(484).7) .

9. F. Basile , P. Chiacchio and D. Gerbasio , " On the Implementation of Industrial Automation Systems Based on PLC," in IEEE Transactions he Automation Science and Engineering , vol . 10, no . 4, pp . 990-1003 , Oct. 2013, doi : 10.1109/TASE.2012.2226578 (accessed at https://ieeexplore.ieee.org/document/6381490) .

10. Dychka, I. A. Fundamentals of the applied theory of digital automata [Electronic resource] : textbook / I. A. Dychka, V. P. Tarasenko, M. V. Onai ; KPI named after Igor Sikorsky. – Electronic text data (1 file: 23.22 MB). – Kyiv: KPI named after Igor Sikorskyi, 2019. – 506 p. – Name from the screen (access via the link https://ela.kpi.ua/handle/123456789/29295).

11. Kovalchuk, O. V., Buryan, S. O. (2010). Application of various methods in synthesis for complex programs for logical programmable controllers. Promelectro information collection . "Industrial electronics and electrical engineering". (4). 51–53 (access via link https://ela.kpi.ua/bitstream/123456789/38235/1/09.pdf).

12. Automation of technological processes, installations and complexes [Electronic resource]: methodical instructions for practical classes and execution of calculation and graphic work for students of the training direction 6.050702 "Electromechanics" / NTUU "KPI"; structure. O. V. Kovalchuk, S. O. Buryan. – Electronic text data (1 file: 2.97 MB). - Kyiv: NTUU "KPI", 2010. - Title from the screen (access via the link https://ela.kpi.ua/handle/123456789/405).

13. Vingron , SP (2012). Logic circuit design : Selected methods . Springer Science & Business Media .

Educational content

5. Methods of mastering an educational discipline (educational component)

Lecture classes

No s/p	*The name of the topic of the lecture and a list of main questions (list of didactic tools, links to information sources)*
1	***Topic 1.1. Elements of algebra-logic.*** *Main questions: binary algebra of logic – a mathematical apparatus for the analysis and synthesis of relay circuits; concepts of relays and contacts; the principle of operation of the relay device; mathematical description of the relay device; logical variable and logical function; constituents of one and zero; basic logical functions.*
2	***Topic 1.2. Axioms and laws of algebra-logic.*** *Basic questions: axioms of algebra-logic; the basic laws of logic algebra, based on the application of conjunction, disjunction and inversion operations; examples of applying the laws of algebra-logic; proof of some laws of algebra-logic.*
3	***Topic 1.3. Normal and perfect normal forms of logical functions. Part 1.*** *Main questions: disjunctive normal form (DNF) and perfected disjunctive normal form (DDNF) of a logical function; compilation of DDNF according to the truth table; compiling a truth table for the function given in DNF and DDNF; deployment of DNF in DDNF; properties of DDNF.*
4	***Topic 1.3. Normal and perfect normal forms of logical functions. Part 2.*** *Main questions: conjunctive normal form (CNF) and complete conjunctive normal form (DCNF) of a logical function; compilation of DKNF according to the truth table; drawing up a truth table according to the function presented in KNF and DCNF; deployment of KNF in DKNF; properties of DKNF.* ***Topic 1.4. Functions of one and two variables. Part 1.*** *The main questions: determining the dependence of the number of functions that can be obtained from different numbers of arguments; representation of the truth table for a function of one variable; definition of functions of one variable and their representation in the form of mathematical equations, relay- contactor scheme and logical element.*
5	***Topic 1.4. Functions of one and two variables. Part 2*** *Main questions: presentation of the truth table for a function of two variables; definition of functions of two variables and their representation in the form of mathematical equations and logical elements; rules for labeling logical elements based on DSTU and ANSI .* ***Topic 1.5. Application of Carnot maps to minimize logical functions. Part 1*** *The main questions: the concept of the Carnot map, as a way of representing a logical function; rules for filling the Carnot map with ones and zeros according to a given logical function in the form of KND, DNF and truth table; the concept of neighboring cells in the Carnot map.*
6	***Topic 1.5. Application of Carnot maps for minimization of logical functions. Part 2***

	Main questions: rules for combining neighboring cells of the Carnot map into contours; union of adjacent contours; minimization of a logical function using the Carnot map; writing the minimized function in the form of KNF and DNF.
7	***Topic 2.1. Synthesis of single-cycle circuits*** *Main questions: the concept of a single-stroke circuit; the sequence of synthesis of single-stroke circuits by the method of truth tables and Carnot maps; examples of synthesis of single-cycle circuits; modeling the operation of a logic circuit in the MatLab / Simulink environment .*
8	***Topic 2.2. Designing electrical principle circuits on integrated microcircuits*** *Main questions: typical industrial microcircuits of the 7400 series; designation of the terminals of the microcircuits on the electrical principle diagrams; rules for marking buttons, LEDs, limit switches, logic elements and other elements on electrical schematic diagrams; rules for compiling a list of elements for electrical principle schemes.*
9	***Topic 2.3. Synthesis of multi-stroke circuits by the method of transition tables and Carnot maps. Part 1.*** *Main questions: the concept of a multi-cycle circuit, the main differences from a single-cycle circuit ; the principle of drawing up and filling in the table of transitions; compression rules of the transition table; rules for compiling Carnot maps for intermediate and output variables.*
10	***Topic 2.3. Synthesis of multi-stroke circuits by the method of transition tables and Carnot maps. Part 2.*** *The main questions: an example of the synthesis of a multi-stroke circuit by the method of transition tables and Carnot maps, in which the number of intermediate variables is more than one; rules for constructing a correspondence map for intermediate variables.*
11	***Topic 2.4. Synthesis of schemes with technological delays by the method of transition tables and Carnot maps*** *Main questions: the concept of technological delay and the principle of time relay operation; rules for marking time delays on the transition table; compression of the transition table with time delays; rules for drawing correspondence maps for intermediate variables and timers; the principle of expanding the correspondence map and increasing the number of intermediate variables.*
12	***Topic 2.5. Synthesis of multi-stroke circuits by the cyclogram method. Part 1*** *Main questions: concept of cyclogram; basic definitions: beat, period, on beat, off beat, on period, off period, on period, off period; the first, second and third checks of the realizability of cyclograms; drawing up equations for the original elements.*
13	***Topic 2.5. Synthesis of multi-stroke circuits by the cyclogram method. Part 2*** *Main questions: examples of the synthesis of schemes according to the given working conditions based on cyclograms; taking into account the effect of self-locking for cyclograms with several switching periods.*
14	***Topic 2.6. Synthesis of schemes with technological delays by the cyclogram method*** *Main questions: designation of time delays on cyclograms; peculiarities of making equations for timers; examples of the synthesis of schemes with technological delays by the cyclogram method.*
15	***Topic 2.7. Synthesis of control schemes based on a clock divider. Part 1.*** *Main questions: concept of clock divider and memory circuits; presentation of memory schemes on AND-NOT and OR-NOT elements; mathematical description of memory circuits; rules for combining memory circuits; the concept of a unit pulse generator.*
16	***Topic 2.7. Synthesis of control circuits based on a clock divider. Part 2***

	Main questions: rules for drawing up a table of states for synthesizing circuits using the clock divider method; obtaining a mathematical description of the automation system according to the table of states; an example of circuit synthesis using the clock divider method.
17	***Topic 2.8. Design of electrical principle circuits on integrated microcircuits with power equipment*** *Main questions: the concept of galvanic separation on the diagrams; the principle of connecting power elements of the circuit (motors, contactors, etc.); an example of assembling an electrical circuit diagram with timers and motors.*
18	***Topic 2.9. Number systems**** *Basic questions: basic number systems: binary, decimal, binary -decimal, hexadecimal ; rules for converting numbers from one system to another.* **The topic is given for independent study at any time during the semester* ***Test*** *At the test, the final grade is announced, which is placed in the test and examination list. Students who did not score 60 points, as well as those who want to improve their grade, perform a credit test in class. Students who are not admitted to the credit can submit arrears during the class. If a non-admitted student was able to gain admission during the class and has more than 60 points, he receives a passing grade in the same class. If the student passed, but did not score 60 points, he also has the right to write a credit test paper. Students who are not admitted to the class, as well as those who did not show up for the test and do not have admission, receive the notice "not admitted" and are sent to an additional session.* *Students who have been admitted in advance and agree with their assessment may not attend the credit class.*

Practical classes

No s/p	*Name of the subject of the lesson and list of main questions*
1	*Practical class #1-2. Intuitive development of automation schemes according to given working conditions.* *The main questions of the lesson: concepts of relays, contacts and relay- contactor schemes; assembly of relay- contactor circuits according to the given operating conditions using an intuitive method without using mathematical description and synthesis methods; connecting the power part of the circuit (asynchronous motors) to the contacts of the contactors.*
2	*Practical class #3-4. Application of the laws of logic algebra for the transformation of logical functions.* *The main questions of the lesson: definition of inversions of logical expressions; proving the identity of logical functions; minimization of given logical functions by the method of direct use of the laws of algebra-logic.*
3	*Practical lesson No. 5-6. Carnot maps.* *The main questions of the lesson: drawing up Carnot maps according to the given logical functions; minimization of logical functions using Carnot maps in the form of disjunctive and conjunctive normal forms; minimization of logic functions using Carnot maps in the presence of undefined states of the logic circuit.*
4	*Practical lesson No. 7-8. Synthesis of single-cycle circuits.*

	The main questions of the lesson: the use of the method of synthesis of single-stroke circuits according to the given working conditions; construction of relay- contactor circuits and circuits on logical elements according to logical expressions obtained on the basis of synthesis.
5	*Practical class #9-10. Synthesis of multi-stroke circuits by the method of transition tables and Carnot maps.* *The main questions of the lesson: the rules for drawing up a table of transitions according to the given working conditions; compression rules of the transition table; construction of status correspondence maps; rules for compiling Carnot maps for output and intermediate signals; construction of relay- contactor schemes and schemes on logical elements according to logical expressions obtained on the basis of synthesis; construction of electrical principle diagrams on integrated microcircuits of the 7400 series.*
6	*Practical class #11-12. Synthesis of schemes with technological delays by the method of transition tables and Carnot maps.* *The main questions of the lesson: the rules for drawing up a table of transitions according to the given working conditions in the presence of technological delays in the scheme; rules for compression of the transition table in the presence of timers; construction of status correspondence maps in the presence of timers; rules for compiling Carnot maps for output and intermediate signals; construction of relay- contactor circuits and circuits on logic elements with timers based on logical expressions obtained on the basis of synthesis.*
7	*Practical class #13-14. Synthesis of multi-stroke circuits by the cyclogram method .* *The main questions of the lesson: rules for constructing cyclograms according to the given conditions of operation of the scheme; the use of the cyclogram method for the synthesis of multi-stroke circuits according to the specified operating conditions; construction of relay- contactor circuits and circuits on logical elements according to logical expressions obtained on the basis of synthesis.*
8	*Practical class #15-16. Synthesis of schemes with technological delays based on cyclograms.* *The main questions of the lesson: the rules for constructing cyclograms according to the given conditions of operation of the scheme in the presence of technological delays; the use of the cyclogram method for the synthesis of multi-stroke circuits under the specified operating conditions in the presence of technological delays; construction of relay-contactor circuits and circuits on logic elements with timers based on logic expressions obtained on the basis of synthesis.*
9	*Practical class #17-18. Synthesis of control circuits based on a clock divider.* *The main questions of the lesson: the rules for compiling a table describing the operation of the scheme; rules for compiling logic equations according to a ready-made table describing the operation of the scheme; construction of memory circuits based on OR-NOT and AND-NOT logical elements.*

Calculation and graphic work (RGR)

As an individual task, students perform calculation and graphic work (RGR). To avoid overloading students at the end of the semester, which is associated with the possible accumulation of individual tasks, laboratory works, etc. from other disciplines, this RGR is divided into 2 parts, which are completed and submitted during the semester immediately after studying the relevant topics. The first part is intended for students to consolidate their knowledge of axioms, laws and theorems of algebra-logic, as well as Carnot maps, synthesis of one-stroke circuits and rules for constructing circuits on logical elements. The second part is intended for consolidating knowledge of the methods of synthesizing multi-stroke circuits using the cyclogram

method and the method of transition tables and Carnot maps. The topics and tasks for RGR are given in [4] section "Basic literature".

Student's independent work

No s/p	*Type of independent work*	*Number hours of SRS*
1	*Preparation for practical classes and doing homework*	*25*
2	*Elaboration of Topic 2.9. Numerical systems*	*2*
3	*Taking tests before lectures*	*3*
5	*Implementation and protection of RGR*	*10*
6	*Preparation for MKR*	*2*
7	*Preparation for the test*	*6*
	In total	***48***

6. Control works

The purpose of the tests is to consolidate and verify theoretical knowledge from the credit module, students to acquire practical skills of independent problem solving.

One modular test is divided into two tests of one hour each. Tests are conducted in the Moodle environment . Each student receives an individual assignment to which written answers must be provided and sent to Moodle . The first test is conducted after studying Topic 2.1 and is devoted to the laws of algebra-logic, synthesis of single-stroke circuits and Carnot maps. The second control work is carried out after studying Topic 2.6 and is devoted to the synthesis of multi-stroke circuits by the cyclogram method.

Policy and control

6. Policy of academic discipline (educational component)

The system of requirements that the teacher sets before the student:

- *rules for attending classes: in accordance with Order 1-273 dated 14.09.2020, it is prohibited to evaluate the presence or absence of the winner at the classroom class, including the awarding of incentive or penalty points. According to the RSO of this discipline, points are awarded for the relevant types of educational activity in lectures and practical classes.*
- *rules of behavior in classes: the student has the opportunity to receive points for the appropriate types of educational activity in lectures and practical classes, provided for by the RSO of the discipline. The use of means of communication to search for information on the teacher's Google Drive , on the Internet, in a distance course on the Sikorsky platform is carried out on the condition that the teacher instructs;*
- *policy of deadlines and rescheduling: if a student does not pass or does not appear at the MKR (without a good reason), his result is evaluated at 0 points. Recompilation of MKR results is not provided for;*
- *policy on academic integrity: the Code of Honor of the National Technical University of Ukraine "Kyiv Polytechnic Institute" https://kpi.ua/files/honorcode.pdf establishes general moral principles, rules of ethical behavior of individuals and provides a policy of academic integrity for persons working and studying at the university, which they should be guided by in their activities, including when studying and preparing control measures in the discipline "Synthesis of Logical Schemes";*

- *when using digital means of communication with the teacher (mobile communication, e-mail, correspondence on forums and social networks, etc.), it is necessary to observe generally accepted ethical norms, in particular, be polite and limit communication to the working hours of the teacher;*
- *recognition of learning results acquired in non-formal/ informal education is carried out in accordance with the "Regulations on recognition in KPI named after Igor Sikorskyi of learning outcomes acquired in non-formal/ informal education". Courses (including online), seminars, trainings, etc. related to the subject of this discipline may be recognized.*

7. Types of control and rating system for evaluating learning outcomes (RSO)

***Current control** : testing, MKR, performance of tasks for practical classes and RGR.*
***Calendar control** : is carried out twice a semester as a monitoring of the current state of meeting the requirements of the syllabus .*
***Semester control:** assessment.*
***Conditions for admission to semester control** : semester rating of more than 30 points.*
Table of correspondence of rating points to grades on the university scale:

Number of points	Rating
95-100	Perfectly
85-94	Very good
75-84	Good
65-74	Satisfactorily
60-64	Enough
Less than 60	Unsatisfactorily
Less than 30	Not allowed

The student's overall rating after the end of the semester consists of points obtained for:

- *testing for each lecture session;*
- *performance of tasks for practical classes;*
- *performance and protection of calculation and graphic work;*
- *execution of modular control works (MCR);*
- *performance of additional tasks.*

Testing by lectures	Practical classes	RGR Part 1	RGR Part 2	MKR 1	MKR 2	Additional points
18	18	20	20	12	12	until 10

Testing on the materials of lecture classes

***Weighted point 1.** The maximum number of points for testing is 1 point * 18 lectures = 18 points.*

Testing is conducted in the Moodle distance learning system and is available within 2 working days after the end of the current lecture. In some cases, the term of passing the test can be extended by the lecturer. The duration of one test is 10 minutes. The number of attempts is one. In some cases, related to technical problems of students, a re-attempt for individual tests may be given .

Each test contains 10 questions of different formats (choosing the correct option from the list; true/false; matching; numerical answer; choosing the missing words; dragging on the image, etc.).

Evaluation criteria

- *questions such as "choosing the correct option from the list", "true/false", "numerical answer" are evaluated unambiguously: a correct answer - 0.1 point, an incorrect answer - 0 points;*

- *questions that do not have one specific answer, such as "determine the correspondence", "select the missing words", "drag to the image" are evaluated according to the number of elements in the test (for example, if you need to insert 4 words into the text, then the student will receive 0.025 points for one correctly inserted word, and for all 4 correctly inserted words will receive 0.1 point respectively) - incorrect answer - 0 points, partially correct answer - 0.01-0.09 points, correct answer 0.1 point.*

Practical classes

Weight score –2 *. The maximum number of points for all practical classes is 2 points * 9 classes = 18 points.*

, students together with the teacher solve tasks according to the subject of the practical class . After each practical session, students receive homework (1-2 problems on the subject of the practical session), which must be solved and submitted to the teacher for verification before the start of the next session (usually it is 2 weeks, but sometimes this time can be changed by the teacher in some specific cases) .

The first practical session usually takes place when the lecture material has not yet been read, so its subject is not related to specific topics of the discipline, but is aimed at testing students' logical thinking and the ability to intuitively, without knowing synthesis methods, draw up schemes for simple logical problems.

Evaluation criteria

- the homework was solved correctly and passed within 2 weeks after the practical lesson - 2 points;

- the homework was solved correctly, but it was submitted more than 2 weeks after the practical lesson - 1 point;

- the homework was solved with minor errors and passed within 2 weeks after the practical lesson - 1.5 points;

- the homework was solved with minor errors and passed within more than 2 weeks after the practical lesson - 0.5 points;

- the homework is solved with significant errors - it is returned for revision.

Calculation and graphic work

The weighted score is 20. *The maximum number of points for 2 parts of the RGR is 40.*

The calculation-graphic work (RGR) consists of two parts, each of which is drawn up and submitted separately by the deadline determined by the lecturer.

Students who have completed the RGR within the deadline set by the teacher and completed it in accordance with the established requirements are allowed to defend for the maximum score. If the RGR is submitted for verification after the set deadline, the maximum score for the RGR defense is halved. The defense of the RGR consists of two stages: oral and written. During the oral defense, the teacher asks questions about the content part of the RGR to determine the student's level of knowledge of the theoretical part and his understanding of problem solving methods. After a successful oral defense, the student receives a written task, which he must solve within a certain time. The student receives the variant of the written assignment in the Moodle environment . The time required to solve it is usually 30 minutes, but it can be changed by the teachers who accept the RGR. Each student is given one attempt to solve the problem.

Evaluation criteria for the oral stage of the RGR:

- timely submission of work, understanding of the presented material, complete answers to questions before the defense - 9-10 points;

- timely submission of work, understanding of the presented material, answers to defense questions with some inaccuracies - 6-8 points;

- - timely submission of work, incomplete understanding of the presented material, answers to defense questions with significant inaccuracies - 1-5 points.

- the work is completed, but the student does not orient himself in the material at all/the work is completed with significant errors - for revision.

Evaluation criteria for the written stage of the RGR:

- the task was solved correctly with insignificant errors - 9-10 points;

- the task is partially solved and (or) with some errors - 4-8 points;

- the problem is almost not solved, or it is solved with significant errors - 1-3 points.

*- the problem is not solved at all - 0 points**

** In the case of receiving 0 points for the written stage of the RGR, the student has the right to ask the teacher accepting the RGR for an additional attempt, however, the maximum score for the written stage is halved.*

Modular control work

The modular test (MKR) with a duration of 2 academic hours is divided into 2 parts with a duration of 1 academic hour each. The weighted score for one part of the MKR is 12. The maximum score for 2 parts of the MKR is 24 points.

Evaluation criteria

During the first part of the MKR, the student is offered 7 tasks. Tasks 1-6 are evaluated from 0 to 1 point depending on the correctness of the solution; task 7 is evaluated from 0 to 6 points: minimization of the function 0-2 points, scheme based on logic elements 0-2 points, relay- contactor scheme 0-2 points.

During the first part of the MKR, the student is offered 2 tasks. Task 1 is evaluated from 0 to 8 points; task 2 is evaluated from 0 to 4 points. In task 1, it is necessary to perform a logic synthesis using the cyclogram method and build a relay- contactor control circuit and a circuit based on logic elements according to the given cyclogram. In task 2, it is necessary to build a cyclogram based on a given sequence of signals, without making a synthesis.

Calendar control is based on the current rating. A condition for a positive assessment is the value of the student's current rating of at least 50% of the maximum possible at the time of assessment.

Additional (bonus) points

The rating system provides additional points for completing additional tasks. One student cannot receive more than 10 bonus points in a semester. When receiving more than 10 points, they are limited to 10. Bonus points can be received for the following types of work: " Events " and "Tasks for lectures".

Events . *Events are special events for students who want to get extra points for solving difficult tasks. Events are activated at a specified time and are active for a limited time. Additional points are awarded only to those students who provided the correct answer and uploaded it on time. The number of points for additional tasks is determined by each event separately. One student cannot receive more than 10 points for events .*

Tasks for lectures. *Students, if they wish, can perform additional tasks based on lecture materials (solve an example , make a diagram, etc.) . 0.5 points are awarded for one additional task. The maximum number of points that can be obtained for assignments before lectures is 5 points.*

The form of semester control is credit

The maximum number of points is 100. A necessary condition for admission to the test is to pass both parts of the RGR and pass all tasks for practical classes. In order to receive credit from the credit module "automatically", you must have a rating of at least 60 points, as well as fulfill the conditions for admission to the credit.

Students who have a rating of less than 60 points at the end of the semester, as well as those who want to improve their grade in the ECTS system, take a credit test. At the same time, the points scored by the student are canceled, and the grade for the credit test is final.

Remedial work. *Credit work is done at the last lecture session. The student takes the test in the Moodle environment . 100 tests are offered for testing, each of which is valued at 1 point. In order to receive a positive assessment, it is necessary to score 60 points and above. The test time is usually 100 minutes, but may be adjusted by the lecturer and/or teachers taking the credit.*

Working program of the academic discipline (syllabus):

Compiled by an associate professor of the Department of Automation of Electromechanical Systems and Electric Drives of the FEA , Ph.D. Buryan S.O.

Approved by the Department of Automation of Electromechanical Systems and Electric Drives of the FEA (Protocol No. 15 dated 13.06.2024)

Agreed by the Methodical Commission of the faculty (protocol No. 10 dated 06/20/2024)