National Technical University of Ukraine
Igor Sikorsky Kyiv Polytechnic Institute "

Department of
Electromechanical Systems
Automation and Electrical
Drives

ELECTROMECHANICAL SYSTEMS OF TYPICAL TECHNOLOGICAL APPLICATIONS

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	*Daytime*
Year of training, semester	*And V course, first semester*
Scope of the discipline	*150 hours / 5 ECTS credits*
Semester control/ control measures	*Exam/MCR*
Class schedule	*http://rozklad.kpi.ua*
Language of teaching	*Ukrainian*
Information about the head of the course / teachers	Lecturer: *Ph.D., prof. Mykola Valentinovych Pechenyk , , 0677831011* Laboratory works: *Mykola Vasyliovych Pushkar, 0975088258*
Placement of the course	*https://do.ipo.kpi.ua/course/view.php?id=321*

Program of study discipline

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

The syllabus of the study discipline "Electromechanical systems of typical technological applications " is compiled in accordance with the educational program "Electromechanical systems of automation, electric drive and electromobility " of bachelor's training in specialty 141 - Electric power, electrical engineering and electromechanics.
The purpose of the educational discipline *there is the formation and consolidation of the following abilities in students: (ZK02) Ability to apply knowledge in practical situations; (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; (ZK07) Ability to work in a team; (ZK08) Ability to work autonomously; (F K05) Ability to solve complex specialized tasks and practical problems related to the operation of electric machines, devices and automated electric drives; (FK07) Ability to develop projects of electric power, electrotechnical and electromechanical equipment in compliance with the requirements of legislation, standards and specifications; (FK09) Awareness of the need to improve the efficiency*

of electric power, electrotechnical and electromechanical equipment; (FC10) Awareness of the need to constantly expand one's own knowledge about new technologies in electric power, electrical engineering and electromechanics; (FC11) Ability to quickly take effective measures in emergency (emergency) situations in electric power and electromechanical systems; (FC13) Ability to use modeling software packages for analysis, synthesis and research of electromechanical automation systems and electric drives; (FC15); The ability to perform calculations of the mechanical part of the electric drive, mechanical transients, calculate the parameters of DC and AC motors, perform their modeling and analysis; (Φ K 16) The ability to solve complex problems related to the control of automated electric drives of various technological applications with direct and alternating current electric drives

The subject of the educational discipline *is advanced methods of analysis of operating modes of electromechanical systems during the design of complex electric drives of mechanisms of general industrial purpose, taking into account the peculiarities of their technological process.*

Program learning outcomes that the discipline aims to improve

(PRNO3) Know the principles of operation of electric machines, devices and automated electric drives and be able to use them to solve practical problems in professional activities; (PRN06) Apply application software, microcontrollers and microprocessor technology to solve practical problems in professional activities; (PRN07) Carry out process analysis in electric power, electrotechnical and electromechanical equipment, relevant complexes and systems; (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 its relevance and reliability; (PRN11) To communicate freely about professional problems in national and foreign languages orally and in writing, to discuss the results of professional activities with specialists and non-specialists, to 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; (PRN25) Know ways to improve the efficiency of algorithms for controlling electric drives, electromechanical systems, the basics of the theory of electromobility

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 possess educational components "Electric drive", "Theory of automatic control", "Electric machines", "Automated electric drive". Competences, knowledge and skills acquired during the study of the educational component are necessary for further study of the educational component " Course work on electromechanical systems of typical technological applications ", passing of pre-diploma practice and preparation of a diploma project .

3. Content of the academic discipline

Chapter 1. General information and classification of mechanisms of typical technological applications.

Topic 1.1. Purpose, composition and classification of mechanisms.

Section 2 . Electromechanical systems of mechanisms of cyclic action.

Topic 2.1. Electric drive and automation of mechanisms of lifting cranes.

Topic 2.2. Electromechanical systems of single-bucket excavators.

Chapter 3 . Electromechanical systems of mechanisms of continuous action.

Topic 3.1. Electric drive and automation of continuous transport systems.

Topic 3.2. Principles of construction of belt conveyor control systems.

Chapter 4. Electromechanical systems of elevator lifting installations.

Topic 4.1. Electric drive and automation of elevator lifting installations.

4. Educational materials and resources

Basic literature

1. Limonov L.G. Automated and industrial electric drive mechanisms . Kharkiv : "FORT" publishing house, 2009.-p.257.

2. Popovych N.G., Matsko B.M. Lifting installations./ Teaching method. manual .- Kyiv : NTUU "KPI", 2002.- p. 149.

3. Korenkova T.V., Serdyuk O.O., Kovalchuk V.G. Operating modes of pump and fan installations with an automated electric drive. / Learn manual. - Kremenchuk, 2014. - p. 200.

4. V.S. Bondarev, O.I. Dubinets . and others. Lifting and transport machines , calculations lifting and transport machines. Textbook universities . – Kyiv ; Higher school, 2009. - p. 261.

5. Grigorov O.P., Petrenko N.O. Forklifts cars Educational guide . - Kharkiv , NTU "KhPI" 2005. - 204 p.

6. Shevchuk S.P., Popovych A.N., Svitlytskyi V.M. Pump , fan and pneumatic installations. Textbook for higher education educational institutions of NTUU "KPI". - 246 p.

*. **Additional literature***

1. Zakladnyi O.M., Pakhovnyk A.V., Solovei O.I. Energy saving by means of an industrial electric drive. / Learn manual. - Kyiv: Condor, 2005. - p. 408.

2. Korenkova T.V., Gladyr A.I., Aleksova Yu.V. Examples and tests task from automated electric drive typical industrial mechanisms./ Education . manual. - Kremenchuk, 2014. - p. 192.

3. Pechenyk M.V., Buryan S.O. Methodical instructions for practical classes on the course "Electromechanical automation systems of general industrial installations". Kyiv: NTUU "KPI", 2017.-p.96.

4. Chornyi O.P., Lugovoi A.V., Rodbkin D.Y., Sisyuk G.Yu., Sadovoi A.V.. Modeling electromechanical systems. / Textbook .- Kremenchuk , 2008.-p.376.

5. Electromechanical systems automation general industrial mechanisms : Course work [Electronic resource]: teach help for acquirers bachelor's degree in education program " Electromechanical systems automation , electric drive and electric mobility " specialty 141 " Electric power , electrical engineering and electromechanics " / KPI named after Igor Sikorskyi ; edited by: Pechenyk M.V., Buryan S.O., Zemlyanukhina G.Yu. – Kyiv : KPI named after Igor Sikorsky , 2020. – 60 p.

6 . Electromechanical systems automation general industrial mechanisms : Laboratory workshop [Electronic resource]: teach help for acquirers bachelor's degree in education program " Electromechanical systems automation , electric drive and electric mobility " specialty 141 " Electric power , electrical engineering and electromechanics " / KPI named after Igor Sikorskyi ; edited by: Pechenyk M.V., Buryan S.O., Zemlyanukhina G.Yu. – Kyiv : KPI named after Igor Sikorsky , 2020. – 80 p.

7. Beshta O.S., Balakhontsiv O.V. Electric drive mines lifting installations. Prospects development // Mining electromechanics and automation. – 2007. – issue 78/2007, p. 115-118.

8. Ostroukhov I.O., Borysenko V.F. Comparative analysis of electric drive systems mines lifting installations. // Collection worked DonNTU . - 2005. - p. 143-145.

9. M. Pechenik, S. Burian, H. Zemlianukhina and M. Pushkar, "Investigation of the Hydraulic Pressure Stabilization Accuracy in the Conditions of Water Supply Cascade Pump System Operation," 2020 IEEE 7th International Conference on Energy Smart Systems (ESS) , Kyiv, Ukraine, 2020, pp. 97-100, doi : 10.1109/ESS50319.2020.9160340 .

10. M. Pechenik , S. Burian , H. Zemlianukhina and H. Voyat , " Analysis of the Given Law Accuracy of a Mine Skip Lifting Unit Movement Using a Vector-Controlled Electric Drive System ," 2020 IEEE Problems of Automated Electrodrive . Theory and Practice (PAEP), Kremenchuk , Ukraine , 2020, pp . 1-4, doi : 10.1109/PAEP49887.2020.9240893.

11. Pechenyk M.V. Analysis of operating modes of the electric drive of the suspended cable car when using the vector control system / M.V. Pechenyk , S.O. Buryan, G.Yu. Zemlyanukhina , D.V. Rudnev // Proceedings of the Institute of Electrodynamics of the National Academy of Sciences of Ukraine. – 2021. – Issue 58. – pp. 39–43.

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15. Pechenyk M.V. Possibilities of increasing energy effectiveness Electromechanical conveyor systems / M. V. Pechenyk , S. O. Buryan, A. O. Horbatovsky // Bulletin of NTUU "KhPI", Series : Problems automatic electric drive theory and practice. - Kharkiv: - 2013. - No. 36. - pp. 65-72

16. M. V. Pechenyk M. V., Buryan, S. O., & Kotenko , M. G. (2022). Study of the modes of operation of the electromechanical system of the elevator lifting installation when using a vector-controlled Pechenik asynchronous electric motor. Renewable Energy, 1(68), 37-42. https://doi.org/10.36296/1819-8058.2022.1(68)841

17. Pechenik , M., Burian , S., Zemlianukhina , H., Pushkar , M., & Teriaiev , V. (2022). investigation of energy efficiency of water supply system when powered by an alternative energy source . Technical Electrodynamics , (5), 77-81. https://doi.org/10.15407/techned2022.05.077)

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19. M. Pechinik , M. Pushkar , S. Burian and L. Kazmina , " Investigation of Energy Characteristics of the Electromechanical System in Multi-motor Conveyors under Variation of Traction Load Level he the Belt ," 2019 IEEE 6th International Conference he Energy Smart Systems (ESS), Kyiv , Ukraine , 2019, pp . 303-306. (SCOPUS)

2 0 . M. Pechenik , S. Burian , H. Zemlianukhina and H. Voyat , " Analysis of the Given Law Accuracy of a Mine Skip Lifting Unit Movement Using a Vector-Controlled Electric Drive System ," 2020 IEEE Problems of Automated Electrodrive . Theory and Practice (PAEP), Kremenchuk , Ukraine, 2020, pp . 1-4, doi : 10.1109/PAEP49887.2020.9240893

21. Pechenyk , M. V., Buryan, S. O., & Maliborskyi , S. O. (2021). Analysis of the nature of working out the dynamic error according to the speed of the electromechanical system caused by an artificial change in the load in the automated metalworking complex. Bulletin of Vinnytsia Polytechnic Institute, (5), 103-107. DOI: https://doi.org/10.31649/1997-9266-2021-158-5-103-107

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.*** **Purpose, composition and classification of mechanisms.** *Main questions: Purpose and scope of application of typical technological mechanisms; classification by the nature of the technological process; classification features.*
2	***Topic 2.1. Electric drive and automation of mechanisms of lifting cranes. Part 1. Technological schemes and modes of operation of lifting cranes, static loads of crane lifting mechanisms*** *Main questions: analysis of technological schemes; modes of operation and characteristics of mechanisms; static and dynamic loads of lifting mechanisms.*
3	***Topic 2.1. Electric drive and automation of mechanisms of lifting cranes. Part 2. Static and dynamic loads of mechanisms for moving and turning cranes.*** *Main issues: determination of static loads when the mechanism platform is positioned horizontally and at an angle; the effect of wind load on the magnitude of the static moment.*
4	***Topic 2.1. Electric drive and automation of mechanisms of lifting cranes. Part 3. Selection of electric motors of crane mechanisms.*** *Main issues: definition of requirements for electromechanical systems of crane mechanisms; the main types of electric motors used in lifting cranes; algorithm for calculation and selection of electric motors of mechanisms with large inertial masses.*
5	***Topic 2.1. Electric drive and automation of mechanisms of lifting cranes. Part 4. Electric drive systems of crane mechanisms.*** *Main issues: controller management; analysis of electric drives of crane mechanisms.*
6	***Topic 2.1. Electric drive and automation of mechanisms of lifting cranes. Part 5. Principles of construction of control schemes of crane electric drives using controllers.*** *Main questions: control schemes using DC motors with series excitation.*
7	***Topic 2.1. Electric drive and automation of mechanisms of lifting cranes. Part 6. Principles of building control systems for automated electric drives of crane mechanisms.*** *Main issues: control schemes using magnetic controllers; automatic control systems using a controlled voltage converter; modes of operation; the structure of the control system.*
8	***Topic 2.1. Electric drive and automation of mechanisms of lifting cranes. Part 7. Electric drive systems of heavy lifting cranes.*** *The main questions: the principle of operation of the voltage regulation unit on the side of the stator of an asynchronous electric motor; a closed system of speed regulation when using a thyristor switch in the rotor circuit of an electric motor; analysis of robot modes of the complete electric drive of crane mechanisms of the "ATRK" series.*
9	***Topic 2.2. Electromechanical systems of single-bucket excavators. Part 1. Technological schemes and modes of operation of mechanisms of single-bucket excavators.***

	Main issues: technological scheme and modes of operation of the "shovel" type excavator; technological scheme and modes of operation of the "dragline" type excavator; scope of application; requirements for electric drives of excavators.
10	***Topic 2.2. Electromechanical systems of single-bucket excavators. Part 2. Peculiarities of construction of control schemes of excavator mechanisms.*** *Main questions: basic mechanical characteristics; the principle of construction of the power part of electromechanical systems; the principle of operation of automatic control schemes of lifting and turning mechanisms - the movement of the excavator "ECG 4.6B".*
11	***Topic 2.2. Electromechanical systems of single-bucket excavators. Part 3. Typical unified structure of an excavator electric drive.*** *Main issues: characteristics and purpose of elements of a typical unified structure; formation of regulation contours; principles of forming the required mechanical characteristics; adjustment of speed and current regulation circuits; electric drive system according to the "TV-HD" scheme; control scheme of the two-motor electric drive of the excavator's turning mechanism.*
12	***Topic 3.1. Electric drive and automation of continuous transport systems. Part 1. Technological schemes and modes of operation of mechanisms of continuous transport*** *Main issues: technological schemes and modes of operation of belt and chain conveyors, escalators and suspended cableways; analysis and characteristics of mechanisms; areas of application.*
13	***Topic 3.1. Electric drive and automation of continuous transport systems. Part 2. Static loads of the belt conveyor electric drive.*** *Main issues: static forces on straight and curved sections of the conveyor; traction calculation along the closed contour of the traction element; determination of static force.*
14	***Topic 3.1. Electric drive and automation of continuous transport systems. Part 3. Modes of operation of the conveyor in the absence of slippage of the belt relative to the drum of the drive station .*** *Main issues: use of Eller's method to ensure conveyor operation without slipping in static and dynamic modes of operation.*
15	***Topic 3.1. Electric drive and automation of continuous transport systems. Part 4. Calculation of power of belt conveyor electric motors.*** *Main issues: power calculation algorithm and determination of the location of the drive station city; calculation example.*
16	***Topic 3.2. Principles construction of control systems tape conveyors . Part 1. Analytical review of conveyor electric drives.*** *Main issues: requirements for electromechanical systems of conveyors; analysis of conveyor electric drive systems.*
17	***Topic 3.2. Principles construction of control systems tape conveyors . Part 2. The principle of construction of control systems of transport conveyor lines.*** *The main questions: the principle of operation of the control scheme of electric drives of two conveyors due to the synchronous change of the EMF frequency of the rotors of electric motors; scheme of automatic control of the flow-transport system in the absence of control of the speed of movement of the traction element.*
18	***Topic 3.2. Principles construction of control systems tape conveyors . Part 3. The control system of the flow-transport system in the presence of control over the speed of the belt.*** *Main issues: analysis of start, stop and static operation modes; the principle of signaling for normal and emergency situations.*

19	***Topic 3.2. Principles construction of control systems tape conveyors . Part 4. Multi-motor electric drive of mechanisms of continuous transport.*** *Main questions: features of application; the nature of load distribution in the traction element when using a two-motor electric drive; intermediate electric drive; determination of the number of electric motors along the conveyor belt.*
20	***Topic 3.2. Principles construction of control systems tape conveyors . Part 5. Conveyors with intermediate electric drives on straight sections of the track.*** *Main questions: nature of load distribution on horizontal and inclined sections with different configurations of drive modules; synchronization of the speed of electric motors; analysis of the design of intermediate electric drives.*
21	***Topic 4 . 1 . Electric drive and automation elevators lifting installations. Part 1. General information and classification of elevator lifting installations.*** *Main issues: classification of elevator lifting units (LPU); analysis of the principles of construction of technological schemes of LPU; basic requirements for LPU electric drives.*
22	***Topic 4 . 1 . Electric drive and automation elevators lifting installations. Part 2. Analysis of electric drive systems of elevator lifting installations.*** *Main issues: analysis of electric drives using DC and AC electric motors; the main measures to increase the safety of the LPU operation.*
23	***Topic 4 . 1 . Electric drive and automation elevators lifting installations. Part 3. Lift kinematics. Calculation of static forces of the elevator lifting installation.*** *The main questions: the algorithm for calculating the LPU speed diagram within the work cycle; determination of static loads of LPU; the principle of constructing loading diagrams for balancing and non-balancing LPUs.*
24	***Topic 4 . 1 . Electric drive and automation elevators lifting installations. Part 4. Calculation and construction of load diagrams of electric motors of elevator lifting units.*** *Main issues: construction of loading diagrams for various technological schemes of LPU; power calculation and selection of LPU electric motors.*
25	***Topic 4 . 1 . Electric drive and automation elevators lifting installations. Part 5. Accuracy of elevator cabin positioning.*** *Main issues: analysis of the LPU movement during the cabin stop process; calculation of maximum permissible movement errors; analysis of the parameters of the static characteristics of the electric motor, which are necessary to ensure the required accuracy of stopping the LPU cabin.*
26	***Topic 4 . 1 . Electric drive and automation elevators lifting installations. Part 5. Optimization of diagrams of movement speed of lifting installations.*** *Main issues: peculiarities of changes in the values of acceleration and jerk during the movement of the cabin; implementation of the requirements of the Operational Safety Rules when forming a speed chart; the procedure for optimizing the movement diagram within the LPU work cycle.*
27	***Modular control work.***

Laboratory classes

No s/p	*List of laboratory works*
1	***Laboratory work #1. Study of the static characteristics of a centrifugal pump installation.***
2	***Laboratory work #2. Study of the closed pressure control system of the centrifugal***

	pump installation.
3	***Laboratory work #3. Study of the energy efficiency of the fan installation with different methods of controlling the flow rate.***
4	***Laboratory work #4. Study of the electric drive of the elevator lifting installation.***

Student's independent work

No s/p	Type of independent work	Number hours of SRS
1	*Preparation for lectures*	18
2	*Preparation for laboratory classes*	16
3	*Implementation and protection of RGR*	10
4	*Preparation for MKR*	4
5	*Preparation for the exam*	30

Individual task

The purpose of the individual task is to consolidate theoretical knowledge, to acquire skills of independent solution of problems in the calculation and design of electric drives of general industrial mechanisms.

Students perform computational and graphic work, which includes the following questions: calculation of static and dynamic moments and construction of load diagrams of the electric motor and mechanism. Selection of an electric motor and elements of automated electric drive systems. The topics of individual tasks and requirements for the execution and registration of the RGR are given in the section of Additional literature, item 12.

Control work

The purpose of the control work is to consolidate and verify theoretical knowledge from the educational component, students to acquire practical skills of independent solution of problems in the calculation and design of elements of electromechanical systems of typical technological purpose.

The modular control work (MKR) is carried out during the 9th week of training. Control work is carried out in the Moodle environment . Each student receives an individual task, according to which it is necessary to provide answers to the specified questions.

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 "Modeling of electromechanical systems";*
- *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, to be polite and limit communication to the working hours of the teacher.*

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

Current control *: surveys at lectures, MKR, performance of tasks for laboratory classes, performance of tasks for calculation and graphic work.*
Calendar control *: carried out twice a semester as a monitoring of the current status of meeting the syllabus requirements.*
Semester control: *exam.*
Conditions for admission to semester control *: completed and defended laboratory work, completed and defended calculation and graphic work, 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	Not satisfactory
The conditions for admission to the semester control have not been met	Not allowed

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

- *survey for each lecture session;*
- *performance and protection of laboratory work;*
- *execution of modular control work (MCR);*
- *performance and protection of calculation and graphic work;*
- *answers to questions during the exam.*

Surveys at lectures	Laboratory classes	RGR	MKR	Exam
13.5	12	14.5	10	50

Surveys during lectures

Polls at each lecture session:
- correct answers in each lecture - 0.5 points for each lecture;

- wrong answer or no answer - 0 points.

Performing laboratory work:

The weighted point is equal to 3. The maximum number of points for all 4 laboratory works is 12 points. The maximum score for 1 laboratory work is distributed as follows: admission – 0.5 points; performance – 1.0 points; defense - 1.5 points. The calculation of points for 1 laboratory work is carried out according to the following criterion:

- full answer to admission, active participation in laboratory work, full answer to defense questions - 3.0 points;

- a sufficiently complete answer to admission, active participation in the performance of laboratory work, a sufficiently complete answer or an answer with minor errors to questions before the defense - 2-2.5 points;

- incomplete answer to the admission, inactive participation in the performance of the work, incomplete answer to the defense question - 0.5-1 points;

- unsatisfactory answer to the admission, absence during work, unsatisfactory answer to the defense question - 0 points (compulsory completion of work is required).

The admission to the next laboratory work is the mandatory defense of the previous work at consultations or at the previous lesson.

Modular control work:

- "excellent", complete answer (at least 90% of the required information) - 9-10 points;

- "good", a sufficiently complete answer (at least 75% of the required information), or a complete answer with minor errors - 7-8 points;

- "satisfactory", incomplete answer (at least 60% of the required information) and minor errors - 5-6 points;

- "unsatisfactory", an unsatisfactory answer (does not meet the requirements for 3 points) or absence during the work - 0 points.

Calculation and graphic work:

- "excellent", the work was completed without errors, understanding of the presented material, complete answers to the questions before the defense - 13-14.5 points;

- "good", work done with minor errors, understanding of the presented material, complete answers to defense questions with some errors - 11-13 points;

- "satisfactory", work performed with minor errors, incomplete answers to defense questions - 8-10 points;

- "unsatisfactory", the work was completed with significant errors - 0 points, the work is returned for revision.

2 penalty points, but not more than 5, are accrued for each week of lateness of submission for the defense of calculation and graphic work from the set deadline.

Calendar control

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. The score required for obtaining a positive calendar control is communicated to the students by the teacher no later than 2 weeks before the start of the calendar control.

Exam:

At the exam, students perform a written test. Each task contains three theoretical questions. The list of questions is given in the methodical instructions for mastering the credit module. The first theoretical question is worth 10 points, and the second and third - 20 points.

Evaluation system of the first theoretical question:

- "excellent", complete answer (at least 90% of the required information) - 9-10 points;

- "good", a sufficiently complete answer (at least 75% of the required information), or a complete answer with minor errors - 7-8 points;

- "satisfactory", incomplete answer (at least 60% of the required information) and minor errors - 5-6 points;

- "unsatisfactory", unsatisfactory answer (does not meet the requirements for 3 points) - 0 points.

Evaluation system for the second and third questions:

- "excellent", complete problem-free solution - 18-20 points;

- "good", complete solution of the task with insignificant errors - 15-17 points;

- "satisfactory", the task was completed with certain shortcomings - 12-14 points;

- "unsatisfactory", task not completed - 0 points.

Additional (bonus) points

The rating system provides additional points for completing additional tasks. One student cannot receive more than 5 bonus points in a semester. Bonus points can be obtained for the following types of work: "Events".

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 given only to those students who gave the correct answer and entered a certain number, who were the first to download it. The number of points for additional tasks is determined by each event separately. One student cannot receive more than 5 points for events .*

Working program of the academic discipline (syllabus):

Compiled by a professor of the Department of Automation of Electromechanical Systems and Electric Drives of the FEA, Ph.D. Pechenyk M.V.

Approved by the Department of Automation of Electromechanical Systems and Electric Drives of the FEA (Protocol No. 15 dated June 13, 2024).

Agreed by the Methodical Commission of the Faculty of Electrical Power Engineering and Automation (protocol No. 10 dated 06/20/2024).