



DIAGNOSIS AND OPTIMIZATION OF FUNCTIONING OF ELECTROMECHANICAL ENERGY CONVERTERS AND COMPLEXES BASED ON THEM

Work program of the discipline (Syllabus)

Details of the discipline	
Level of higher education	<i>Third (educational and scientific)</i>
Branch of knowledge	<i>14 "Electrical Engineering"</i>
Specialty	<i>141 "Electric power, electrical engineering and electromechanics"</i>
Educational program	<i>ELECTRIC POWER ENGINEERING, ELECTRICAL ENGINEERING AND ELECTROMECHANICS</i>
Discipline status	<i>Selective</i>
Form of study	<i>Eye (day)</i>
Year of preparation, semester	<i>II course, spring semester</i>
The scope of discipline	<i>90 hours / 3 ECTS credits</i>
Semester control / control measures	<i>Offset / MCR</i>
Timetable	<i>http://rozklad.kpi.ua</i>
Language of instruction	<i>Ukrainian / English</i>
Information about the course leader / teachers	<i>Lecturer: Ph.D. Chumak Vadim Vladimirovich, tel. 0502083843</i>
Course placement	<i>Distance course in the Moodle system https://do.ipk.kpi.ua/login/index.php</i>

Curriculum

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

The program of the discipline "Diagnosis and optimization of electromechanical energy converters and complexes based on them»Compiled in accordance with the educational program" Electric Power, Electrical Engineering and Electromechanics "training doctor of philosophy specialty 141 - Electric Power, Electrical Engineering and Electromechanics.

The purpose of the discipline *is the study of graduate students' modern approaches to improving the functioning of electromechanical systems, development of the latest elemental base with the participation of digital computers, electronic digital converters and development of methods for diagnosing the main components of the complex as a whole.*

The subject of the discipline - *electromechanical energy converters, their parameters, characteristics and principles of increasing the level of their operation, increasing the reliability of work by modern diagnostics.*

Program learning outcomes:

Competences: *Ability to increase the level of EMF and complexes by replacing them with modern ancillary equipment.*

Knowledge: *structure of modern complexes on the basis of EMF, mastering the principles and methods of diagnosing these EM complexes.*

Skills: *To carry out theoretical and practical researches of physical processes of electromechanical conversion of energy in various modes of work of EMPE with use of modern tools, to apply them in own researches and in teaching practice.*

2. Prerequisites and postrequisites of the discipline (place in the structural and logical scheme of education according to the relevant educational program)

Successful study of the discipline is based on the knowledge acquired by the student while studying at the first (bachelor's) and second (master's) levels of higher education. In particular, the knowledge gained during the study of disciplines "Electric machines of automation systems", "Diagnostics and service of electric machines". To successfully master the discipline, the student must have a "Foreign language for scientific activities", as much of the information is presented in the scientific literature in English. Competences, knowledge and skills acquired in the process of studying this discipline are necessary for further study of the mandatory components of the educational and scientific program PhD, as well as for the quality of research on the topic of the dissertation.

3. The content of the discipline

The discipline structurally consists of 3 meaningful subdivisions, namely:

1. Diagnosis of electromechanical energy converters and complexes based on them

Topic 1.1 Introduction. Estimation of EMPE energy parameters.

Topic 1.2 Electromagnetic diagnostics of electric motors of pumps and compressors of technological units.

Topic 1.3. Analysis of EMPE power supply quality indicators.

Topic 1.4. Measurement of resistances of stator and rotor windings.

Topic 1.5. Diagnosis of the main insulation of electrical machines.

Topic 1.6. Diagnosis of interturn insulation of electric machines.

Topic 1.7. Diagnosis of interleaf insulation of magnetic circuits of electric machines.

2. Optimization of functioning of electromechanical energy converters and complexes on their basis

Topic 2.1. EMPE energy indicators and their characteristics.

Topic 2.2. Analysis of the structure of the modern EM-complex on the basis of existing examples.

Topic 2.3. Identification of the main components that affect the efficiency and reliability of EMPE.

Topic 2.4. Theoretical and practical tools for EMPE optimization.

3. Theoretical and practical issues of maintenance of electromechanical complexes.

Topic 3.1. Determining the quality of the main components of electromechanical complexes according to the actual condition.

Topic 3.2. Forecasting the final resource of elements of electromechanical complexes.

Topic 3.3. Determining the need for preventive, medium or major repairs.

Topic 3.4. Models of forecasting the final resource of elements of electromechanical complexes.

Topic 3.5. Forecasting the final resource of EMF and complexes based on them.

4. Training materials and resources

Main information resources:

1. Taran VP Diagnosing electrical equipment. - K .: Техніка, 1983. - 200 с.
2. Titko AI, Vaskovsky YM Scientific bases, methods and means of diagnosing asynchronous electric motors. Our format, Kyiv, 2015, 300 p.
3. EG Khudiy, and II Peltek, "Modern methods of diagnosing the insulation of electric machines," Bulletin of NTU "KhPI": Problems of automated electric drive. Theory and practice, № 28, p. 549-550, 2010.
4. Methodical instructions for laboratory classes in the discipline "Electric Machines". Sections: "Transformers", "Asynchronous machines" for students of electromechanical and electric power specialties / Incl .: VMAndrienko, MGANpilogov, VFShinkarenko. - K .: КПІ, 2001. - 53 с. method office office Electromechanics. INTRANET website.
5. Methodical instructions for laboratory classes in the discipline "Electric Machines". Sections: "Synchronous machines", "DC machines" for students of electromechanical and electric power specialties / Incl .: MO Reutsky, OM Davydov, MG Anpilogov, EM Dubchak. - K .: КPI, 2007. method office of the department. Electromechanics. INTRANET website.
6. DECREE OF THE CABINET OF MINISTERS OF UKRAINE (On standardization and certification). With changes and additions made by the Laws of Ukraine. of June 11, 1997 N 333/97-VR.
7. Jean-Claude Trigeassou Electrical Machines Diagnosis. - ISTE Ltd, 2011. - 327 p.
8. Electrical engineering and electromechanics of railway automation systems [Text]: textbook / MM Babayev, MG Davidenko, GI Zagariy, Yu.V. Sobolev, VS Блиндюк, О.М. Progonny, OM Ananieva, KA Trubchaninov: textbook. - Kharkiv: UkrDAZT, 2011. - 608 p.
9. Sobolev Yu.V. Theory of electric and magnetic circuits [Text] / YV Sobolev, MM Babayev, MG Davydenko, - Kharkiv: HFV "Transport of Ukraine". - 2002. 264p.

Educational content

5. Methods of mastering the discipline (educational component)

Lectures

<i>№ s/ n</i>	<i>The title of the lecture topic and a list of key issues (list of teaching aids, links to information sources)</i>
1	Introduction. Estimation of EMPE energy parameters. Electromagnetic diagnostics of electric motors of pumps and compressors of technological units .. References [1,2]
2	Analysis of EMPE power supply quality indicators. Literature [2,9].
3	Measurement of resistances of stator and rotor windings. Diagnosis of the main

	<i>insulation of electrical machines. Literature [2,16,17].</i>
4	<i>Diagnosis of interturn insulation of electric machines. Literature [2,9,10,21]</i>
5	<i>Diagnosis of interleaf insulation of magnetic circuits of electric machines. Literature [2,14,16,18]</i>
6	<i>EMPE energy indicators and their characteristics. Literature [8, 12, 17].</i>
7	<i>Analysis of the structure of the modern EM-complex on the basis of existing examples. Literature [2,17]</i>
8	<i>Identification of the main components that affect the efficiency and reliability of EMPE. Literature [2,5].</i>
9	<i>Theoretical and practical tools for EMPE optimization. Literature [2,5]</i>
10	<i>Determining the quality of the main components of electromechanical complexes according to the actual condition. Literature [7, 11, 13].</i>
11	<i>Forecasting the final resource of elements of electromechanical complexes. Literature [2, 7, 9].</i>
12	<i>Determining the need for preventive, medium or major repairs. Literature [1,6,6,19]</i>
13	<i>Models of forecasting the final life of elements of electromechanical complexes. Forecasting the final resource of EMF and complexes based on them. Literature [3, 8].</i>
14	<i>Modular control work - 4 years</i>

6. Independent work of a PhD student

Distribution of hours for independent work of PhD students:

<i>№з / п</i>	<i>Type of independent work</i>	<i>Number hours of CPC</i>
1	<i>Preparation for classroom classes</i>	13
2	<i>Execution of RGR</i>	20
3	<i>Preparation for MCR</i>	8
4	<i>Preparation for the test</i>	18
	<i>Total</i>	59

Policy and control

7. Course policy (educational component)

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

- *rules of attendance: in accordance with Order 1-273 of 14.09.2020, it is prohibited to assess the presence or absence of the applicant in the classroom, including the accrual 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 conduct in the classroom: the student has the opportunity to receive points for the relevant types of educational activities in lectures and practical classes provided by the RSO 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 under the guidance of the teacher;*

- *policy of deadlines and rearrangements: if the student did not pass or did not appear at the MCR (without good reason), his result is evaluated at 0 points. Interpretation of MCR results is not provided;*

• *Academic Integrity Policy: 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 conduct of individuals and provides a policy of academic integrity for people who work and study at the university, which they should be guided in their activities, including the study and preparation of control measures in this discipline;*

• *when using digital means of communication with the teacher (mobile communication, e-mail, correspondence on forums and social networks, etc.) it is necessary to adhere to generally accepted ethical norms, in particular to be polite and limit communication during the teacher's working hours.*

8. Types of control and rating system for evaluation of learning outcomes (RSO)

Current control: *express survey, MCR.*

Calendar control: *conducted twice a semester as a monitoring of the current state of compliance with the requirements of the syllabus.*

Semester control: *test.*

The rating system for assessing the learning outcomes of students involves determining the number of points obtained by the student during the study of the discipline.

Conditions of admission to semester control: *the current semester rating must be at least 30 points.*

The current semester rating of the student consists of the points received on:

- *answers during express surveys at lectures;*
- *performing modular control work (MCR).*

Answers during express surveys at lectures

Weight point for one express survey - 1 point.

*The maximum number of points in all lectures is: 1 point * 13 lectures = 13 points.*

Evaluation criteria

- *correct answers to some questions from the place - 1 point;*

Modular control work

The maximum number of points for performing MCR is 17 points.

Evaluation criteria

- *complete answer to the question (more than 90% of the material) 15 - 17 points;*
- *incomplete answer to the question (from 50 to 90% of the material) - 5 - 14 points;*
- *the answer contains less than 50% of correct answers - 0 points;*

Calendar control is based on the current rating. The condition of positive certification is the value of the current rating of the student not less than 50% of the maximum possible, ie 30 points.

The maximum sum of weight points of control measures during the semester is: $RC = 13 + 30 + 17 = 60$ points.

Form of semester control - credit

The final evaluation of learning outcomes is carried out according to the stobal rating scale. The credit component of the scale is equal to 40% of the overall rating scale, ie $RZ = 40$ points. A necessary condition for admission to the test is a complete syllabus of lectures, completed and defended RGR. To receive a test without a semester control ("automatic") you must have a starting rating of at least 60 points, as well as other conditions for admission to the test.

The test consists of two theoretical questions

Credit evaluation criteria

- *complete answer (complete, error-free solution of the problem) $RZ = 39 - 40$ points;*
- *answer with some insignificant errors $R3 = 30 - 38$ points;*

- answer without significant errors, but not with the full amount of information required $P3 = 20 - 29$ points;
- incomplete answer with certain errors $RZ = 12-19$ points;
- incomplete answer with a significant number of errors, but which are not fundamental $RZ = 8-11$ points;
- completely incorrect answer or no answer - 0 points.

The total number of rating points is defined as $RP = RC + R3$

The table of correspondence of total rating points to estimations on the following scale:

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

9. Additional information on the discipline

List of questions to be submitted for semester control

Estimation of EMPE energy parameters.

Electromagnetic diagnostics of electric motors of pumps and compressors of technological units.

Analysis of EMPE power supply quality indicators.

Measurement of resistances of stator and rotor windings.

Diagnosis of the main insulation of electrical machines.

Diagnosis of interturn insulation of electric machines.

Diagnosis of interleaf insulation of magnetic circuits of electric machines.

EMPE energy indicators and their characteristics.

Analysis of the structure of the modern EM-complex on the basis of existing examples.

Identification of the main components that affect the efficiency and reliability of EMPE.

Theoretical and practical tools for EMPE optimization.

Work program of the discipline (syllabus):

Folded Associate Professor of Electromechanics FEA, Ph.D. Chumakom VV

Approved Department of Electromechanics FEA (Minutes № 12 dated 30.06.2020)

Agreed FEA Methodical Commission (protocol № __ from _____)