Ministry of Education and Science of Ukraine
Dnipro University of Technology

Department of Electrical Engineering

«ЗАТВЕРДЖЕНО»
Завідувач кафедри
Ципленков Д.В. _____
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WORK PROGRAM OF THE ACADEMIC DISCIPLINE
«Electrical materials»

Field of knowledge	14 Electrical engineering
Specialty……..	141 Electrical energetics, electrical engineering and electromechanics
Level of higher education …….	first(bachelors)
Degree…….	bachelor
Educational and professional program	«Electrical energetics, electrical engineering and electromechanics»
Specialization	-
Status……	Compulsory
General volume..…….	3 credits (90 hours)
Type of final control	Examination
Terms of training ……..	2nd semester
Language of training	English

Instructors: PhD, associate professor Kolb A.A.

Prolonged: for 20 __ / 20__ academic year _____ (_____) "__" ___ 20__.
(Signature, name, date)

for 20 __ / 20__ academic year _____ (_____) "__" ___ 20__.
(Signature, name, date)

for 20 __ / 20__ academic year _____ (_____) "__" ___ 20__.
(Signature, name, date)

Dnipro University of Technology
2022

The working program of the obligatory educational discipline "Electrotechnical materials" for bachelors of a specialty 141 "Electrical energetics, electrical engineering and electromechanics" / Dnipro University of Technology, Department of Electrical Engineering. - D: NTU «DP» 2022 - 13 p.

Author:

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The work program regulates:

- key goals and objectives;
- the disciplinary learning outcomes generated through the transformation of the intended learning outcomes of the degree program;
- the content of the discipline formed according to the criterion “disciplinary learning outcomes”;
- the discipline program (thematic plan by different types of classes);
- distribution of the discipline workload by different types of classes;
- an algorithm for assessing the level of achievement of disciplinary learning outcomes (scales, tools, procedures and evaluation criteria);
- criteria and procedures for evaluating the academic achievements of applicants by discipline;
- the contents of the educational and methodological support of the discipline;

The work program is designed to implement a competency approach in planning an education process, delivery of the academic discipline, preparing students for control activities, controlling the implementation of educational activities, internal and external quality assurance in higher education, accreditation of degree programs within the specialty.

Approved by the decision of the methodical commission of the specialty 141 "Electrical energetics, electrical engineering and electromechanics" (protocol № 21/22-07 from 14.07.22).

CONTENTS

1 DISCIPLINE OBJECTIVES

In the educational and professional program of the Dnipro University of Technology specialty 141 "Electrical energetics, electrical engineering and electromechanics" the distribution of learning outcomes by organizational forms of the educational process. In particular, the discipline Б6 "Electrical materials" includes the following learning outcomes:

PLO07	To carry out the analysis of processes in the electric power, electrotechnical and electromechanical equipment, the corresponding complexes and systems

The objective of discipline – formation of competencies for the operation of electrical materials

Achieving the goal requires the transformation of program learning outcomes into disciplinary and adequate selection of the content of the discipline according to this criterion.

2 INTENDED DISCIPLINARY LEARNING OUTCOMES

Cipher of PLR	**Disciplinary learning outcomes (DRN)**	
	Cipher of DLR	**content**
PLO07	PLO07.1-Б6	Analyze processes in electrical, electrical and electromechanical equipment, relevant complexes and systems, taking into account the properties of dielectric, conductive and magnetic materials
	PLO07.2-Б6	Calculate the parameters of dielectric, conductive and magnetic materials used in the elements of electric power, electrical electromechanical complexes and systems.

3 BASIC DISCIPLINES

Subjects	**The acquired learning outcomes**
Б1 Higher mathematics Б2 General Physics	To carry out the analysis of processes in the electric power, electrotechnical and electromechanical equipment, the corresponding complexes and systems.
	Select and apply suitable methods for analysis and synthesis of electromechanical and electrical systems with specified parameters.

4 WORKLOAD DISTRIBUTION BY THE FORM OF EDUCATIONAL PROCESS ORGANIZATION AND TYPES OF CLASSES

Types of classes	**Distribution between forms of educational process,** hours							
	Daytime learning			**evening learning**		**Distance learning**		
	Volume	Classroom lessons	Self-study	Classroom lessons	Self-study	Volume	Classroom lessons	Self-study
lectures	45	16	29	-	-	45	4	41
practical	-	-	-	-	-	-	-	-
laboratory	45	16	29	-	-	45	4	41
seminars	-	-	-	-	-	-	-	-
Total	90	32	58	-	-	90	8	82

5 DISCIPLINE PROGRAM BY TYPES OF CLASSES

Cipher of DLR	**Types and topics of training sessions**	**Component's volume,** *hours*
	LECTURES	**45**
PLO07.1-Б6	**1. Dielectric materials**	**25**
	Topic 1. Preface. The main types of chemical bonds.	
	Topic 2. Polarization of dielectric materials in a constant electric field.	
	Topic 3. Types of polarization for different types of dielectrics (gaseous, liquid, solid). Dielectric substitution scheme in terms of polarization.	
	Topic 4. Dielectric constant of different types of dielectrics.	
	Topic 5. Electrical conductivity of dielectrics in a constant electric field.	
	Topic 6. Dielectric losses in an alternating electric field. Equivalent dielectric substitution schemes with dielectric losses.	
	Topic 7. Types of dielectric losses in dielectrics. Dielectric losses for different types of dielectrics (gaseous, liquid, solid).	
	2. Conductive and magnetic materials	**20**
	Topic 1. Preface. Classification of conductive materials. Electrical conductivity of metals.	
	Topic 2. Conductors of high conductivity. Metals and alloys of high resistance.	
	Topic 3. Magnetic materials and basic information. Distribution of materials by magnetic properties.	
	Topic 4. Properties of ferromagnetic materials.	
	Topic 5. The main magnetization curve of ferromagnetic materials. Magnetic hysteresis.	
	Topic 6. Magnetic losses in ferromagnetic materials.	

Cipher of DLR	Types and topics of training sessions	Component's volume, *hours*
	LABORATORY CLASSES	**45**
PLO07.2-Б6	Study of the properties of electrical insulating materials	
	Determination of electrical strength of liquid dielectrics	
	Determination of volume and surface resistivities of solid dielectrics	
	Investigation of dielectric polarization	
	Study of the properties of magnetic materials	
	Investigation of the properties of magnetic materials using an oscilloscope	
	Determination of the specific magnetic resistance of ferromagnets	
	Investigation of magnetic properties of plate samples using a ferrometer	
	TOGETHER	**90**

6 ASSESSMENT OF LEARNING RESULTS

Certification of students' achievement is carried out by transparent procedures based on objective criteria in accordance with the "Regulation of Dnipro University of Technology on the assessment learning results of recipients of higher education".

The achieved competences level regarding to the expected one, that is identified during the assessment procedures, displays factual students' study result on the discipline.

6.1 Scales

Assessment educational achievements of Dnipro University of Technology students' is carried out by the rating (100-point) and the converting scales. The last is needed for conversion of scores obtained by recipients of higher education of different higher educational institutions due to absence of officially approved national scale.

Scales for assessment of educational achievements of Dnipro University of Technology students

Rating scale	Institutional scale
90…100	відмінно / Excellent
74…89	добре / Good
60…73	задовільно / Satisfactory
0…59	незадовільно / Fail

Credits of the academic discipline are certified if a student obtains the total score not less than 60 points. The less score is considered as an academic debt that must be retaken according to Regulations of Dnipro University of Technology on the Organization of the Educational Process.

6.2 Means and procedures

Content of diagnostics means is aimed to monitoring knowledges, skills, communication ability, autonomy, and responsibility of a student at representation his/her study results according to NQF toward the 6th qualification level in relation to established by the working program of academic discipline requirements.

At the assessment procedure, a student must carry out tasks aimed only to demonstration of the discipline study results (Section 2).

Diagnostic means given students at current and final monitoring procedures in the form of tasks must be formed as concretized initial data and the way of demonstration of the disciplinary study results.

Diagnostic means (control tasks) for current and final monitoring procedures are approved by a head of the department.

Types of diagnostics means and procedures of assessment for current and final monitoring the discipline are given below.

Diagnostic means and procedures of assessment

<table>
<tr><th colspan="3">CURRENT MONITORING</th><th colspan="2">FINAL MONITORING</th></tr>
<tr><th>Type of lessons</th><th>Means of monitoring</th><th>Procedures</th><th>Means of monitoring</th><th>Procedures</th></tr>
<tr><td>Lectures</td><td>Control task for each the topic</td><td>completing the assignment during the lecture</td><td rowspan="2">Integrated control work</td><td rowspan="2">Determination of average weighted result of current monitoring

Carrying out a control work during the exam</td></tr>
<tr><td>Laboratory lessons</td><td>verification and protection</td><td>performance of laboratory work</td></tr>
</table>

During the current monitoring, lectures are assessed by determination quality of fulfilment the concretized tasks. Laboratory work is assessed by quality of fulfillment the control or individual tasks.

When content of definite type of lessons includes several components of qualification level description, the integrated score can be determined considering the weight factors that are assigned by an instructor.

When level of current monitoring results on all lesson types is not less than 60 points, the final control is performed without a student participation by determination an average weighted score based on the obtained current scores.

Regardless of results of the current monitoring, each the student has the right to carry out the integrated control work which includes the tasks covering the key discipline study results.

Number of concretized integrated tasks should meet the time allocated for its fulfillment. Number of the integrated task options must provide the task individualization.

A score for the integrated control task is determined as an average score for the task components (i.e., the concretized tasks) and is the final

A score for the integrated control task ca be also determined considering the weight factors for the task components which are set by the department for each a component of qualification description level of the integrated control task.

6.3 Criteria

Factual results of a student's learning are identified and measured relative to the results expected at the assessment procedure with the help of criteria describing actions of a student on demonstration his/her study results.

For assessment control tasks during current control at lectures and practical lessons, the material assimilation factor, that adapts the scores to the rating scale, is used as a criterium:

$$O_i = 100\ a/m,$$

where a – the number of proper answers or essential operations with regards to the solution standard; m – the total number of questions or essential reference operations.

Individual tasks and integrated control works are assessed using criteria characterizing the relationship between requirements to competence levels and indices by the rating scale.

Criteria content is based on competence characteristics defined by NQF for the bachelors' level of higher education which is given below.

General criteria of achievement learning results for the 6th qualification level by the NQF

Description qualification equal	**Requirements to knowledge, skills/abilities, communications, responsibility, and autonomy**	**Score values**
	Knowledge	
♦ conceptual scientific and practical knowledges critical comprehending of theories, principles, methods, and concepts in the field of professional activity/learning	The answer is excellent – correct, substantiated, comprehensive. It is characterized by availability of - conceptual knowledge - high level mastering the state of the matter - critical comprehension the main theories, principles, methods, and concepts in the field of learning and professional activity.	95-100
	The answer contains minor errors or elapses	90-94
	The answer is correct but has some inaccuracies	85-89
	The answer is correct but has some inaccuracies, and is not sufficiently substantiated and comprehensive	80-84

Description qualification equal	Requirements to knowledge, skills/abilities, communications, responsibility, and autonomy	Score values
	The answer is correct but has some inaccuracies, is not sufficiently substantiated and comprehensive	74-79
	The answer is fragmentary	70-73
	The answer demonstrates fuzzy ideas about the object under study	65-69
	Level of knowledge is minimum satisfactory	60-64
	Level of knowledge is unsatisfactory	<60
	Skills/abilities	
♦ in-depth cognitive and practical skills, mastery and innovation at the level required to solve complex specialized tasks and practical problems in the field of professional activity or training	The answer characterizes the ability to: - identify problems - formulate hypotheses - solve problems - choose adequate methods and tools - collect and logically and clearly interpret information - use innovative approaches to solving the problem	95-100
	The answer characterizes the ability / skills to apply knowledge in practice with minor errors	90-94
	The answer characterizes the ability / skills to apply knowledge in practice, but has some inaccuracies in the implementation of one requirement	85-89
	The answer characterizes the ability / skills to apply knowledge in practice, but has some inaccuracies in the implementation of the two requirements	80-84
	The answer characterizes the ability / skills to apply knowledge in practice, but has some inaccuracies in the implementation of the three requirements	74-79
	The answer characterizes the ability / skills to apply knowledge in practice, but has some inaccuracies in the implementation of the four requirements	70-73
	The answer characterizes the ability / skills to apply knowledge in practice when performing tasks on the model	65-69
	The answer characterizes the ability / skills to apply knowledge when performing tasks on the model, but with inaccuracies	60-64
	the level of skills is unsatisfactory	<60
	Communication	
♦ reporting to specialists and non-specialists information, ideas, problems, solutions,	Free possession of industry issues. Clarity of the answer (report). Language: - correct - clean - clear	95-100

Description qualification equal	Requirements to knowledge, skills/abilities, communications, responsibility, and autonomy	Score values
personal experience, and argumentation ♦ collection, interpretation, and application of data ♦ communication on professional issues, including in a foreign language, orally and in writing	- accurate - logical - expressive - concise. Communication strategy: - consistent and consistent development of thought - the presence of logical own judgments - relevant reasoning and its compliance with the defended provisions - correct structure of the answer (report) - correct answers to questions - appropriate technique for answering questions - ability to draw conclusions and formulate proposals	
	Sufficient mastery of industry issues with minor flaws. Sufficient clarity of the answer (report) with minor errors. Appropriate communication strategy with minor flaws	90-94
	Good mastery of industry issues. Good clarity of the answer (report) and appropriate communication strategy (a total of three requirements are not implemented)	85-89
	Good mastery of industry issues. Good clarity of response (report) and appropriate communication strategy (four requirements not implemented in total)	80-84
	Good mastery of industry issues. Good clarity of response (report) and appropriate communication strategy (five requirements not implemented in total)	74-79
	Satisfactory mastery of industry issues. Satisfactory comprehensibility of the answer (report) and appropriate communication strategy (a total of seven requirements have not been implemented)	70-73
	Partial ownership of industry issues. Satisfactory comprehensibility of the answer (report) and communication strategy with errors (a total of nine requirements are not implemented)	65-69
	Fragmentary mastery of industry issues. Satisfactory comprehensibility of the answer (report) and communication strategy with errors (a total of 10 requirements are not implemented)	60-64
	The level of communication is unsatisfactory	<60
Responsibility and autonomy		
♦ managing complex technical or professional activities or projects	Excellent mastery of personal management competencies focused on: 1) management of complex projects, which provides: - research nature of educational activities, marked by the ability to independently assess various life situations,	95-100

Description qualification equal	Requirements to knowledge, skills/abilities, communications, responsibility, and autonomy	Score values
♦ ability to take responsibility for making and approvement decisions in unpredictable work and / or learning contexts ♦ formation of judgments that consider social, scientific and ethical aspects ♦ organization and management of professional development of individuals and groups ♦ ability to continue studies with a significant degree of autonomy	phenomena, facts, to identify and defend a personal position - ability to work in a team - control of own actions 2) responsibility for making decisions in unpredictable conditions, including: - substantiation of own decisions by provisions of normative base of branch and state levels - independence in performing tasks - initiative in discussing problems - responsibility for the relationship 3) responsibility for professional development of individuals and / or groups of persons, which includes: - use of professional-oriented skills - use of evidence with independent and correct argumentation - mastery of all types of educational activities 4) the ability to further study with a high level of autonomy, which includes: - degree of possession of fundamental knowledge - independence of evaluative judgments - high level of formation of general educational skills and abilities - independent search and analysis of information sources	
	Confident mastery of personal management competencies (two requirements are not met)	90-94
	Good mastery of personal management competencies (three requirements are not met)	85-89
	Good mastery of personal management competencies (four requirements not met)	80-84
	Good mastery of personal management competencies (six requirements not met)	74-79
	Satisfactory mastery of personal management competencies (seven requirements not met)	70-73
	Satisfactory mastery of personal management competencies (eight requirements not met)	65-69
	The level of responsibility and autonomy is fragmentary	60-64
	The level of responsibility and autonomy is unsatisfactory	<60

7 TOOLS, EQUIPMENT, AND SOFTWARE

№ works (code)	Lab title	Tools, equipment and software used in the work
ETM-1.1	Study of the properties of electrical insulating materials	Box with prototypes of electrical materials

ETM-1.2	Determination of electrical strength of liquid dielectrics	Installation of ADI-70 Dielectric gloves Dielectric boots Fuses
ETM-1.3	Determination of bulk and surface specific resistance of solid dielectrics	Samples of dielectric materials Theraometer
ETM-1.4	Investigation of dielectric polarization	Samples of dielectric materials AC bridge Electrodes
ETM-2.1	Study of the properties of magnetic materials	Box with prototypes of magnetic materials
ETM-2.2	Investigation of the properties of magnetic materials by using an oscilloscope	Sample of magnetic materials Integrator Oscillograph
ETM-2.3	Determination of the specific magnetic resistance of ferromagnets	Compensator Measuring instruments A sample of a ferromagnet Oscillograph
ETM-2.4	The study of magnetic properties of the plate samples by using ferometra	Plate sample and Ferrometer easuring instruments

8 RECOMMENDED BIBLIOGRAPHIES

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5. Collection of methodical materials for laboratory work on discipline "Electrical Materials" (Section “Magnetic materials”) for students studying specialty 141 “Electrical Power Engineering, Electrical Engineering and Electromechanics” / Kolb AA; Dnipro University of Technology – D.: DniproTech, 2021. – 37 p.

Educational edition

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"Electrical materials"
for bachelors of specialty
141 "Electrical energetics, electrical engineering and electromechanics"

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