Ministry of Education and Science of Ukraine
Dnipro University of Technology

Department of Electrical Engineering

"APPROVED"
Head of Department
Tsyplenkov D.V. _____

31.08.2021

WORK PROGRAM OF THE ACADEMIC DISCIPLINE
«Electrical materials»

Field of study ……..…	14 Electrical engineering
Specialty …….....	141 Electric power engineering, electrical engineering and electromechanics
Educational program … . .… . . .. . . …...	Electric power engineering, electrical engineering and electromechanics
Academic degree ……	first (bachelor's)
Status …….	compulsory
Total volume ..……..	3 ECTS credits (90 hours)
Type of final assessment ……	Final test
Period of study ……..	2nd semester
Language of study …….	English

Lecture: 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 DUT
2021

The working program of the obligatory educational discipline "Electrotechnical materials" for bachelors of a specialty 141 "Electrical Power engineering, electrical engineering and electromechanics " / A.A. Kolb / Dnipro University of Technology, Department of Electrical Engineering. - D: DUT, 2021 - 13 p.

Author:

Kolb A.A., PhD, associate professor Electrical Engineering Department

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 scientific-methodical commission of the specialty 141 "Electric power engineering, electrical engineering and electromechanics" (protocol № 21/22-01 from 30.08.21).

CONTENTS

1 DISCIPLINE OBJECTIVES

In the educational and professional program of the National Technical University "Dnieper Polytechnic" specialty 141 "Electrical Power Engineering, 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:

ПР07	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

Шифр ПРН	**Disciplinary learning outcomes (DRN)**	
	шифр ДРН	**content**
ПР07	ПР07.1-Б6	Analyze processes in electrical, electrical and electromechanical equipment, relevant complexes and systems, taking into account the properties of dielectric, conductive and magnetic materials
	ПР07.2-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
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.
Higher mathematics	ПР07.1-Б1 Know the basics and principles of linear and vector algebra, analytical geometry, differential and integral calculus. ПР07.2-Б1 Be able to use a mathematical apparatus for objective analysis of processes in electromechanical equipment; ПР08.3-Б1 Know the principles of solving technical problems based on mathematical analysis, construction and solution of differential equations.

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

Type of classes	**Workload** hours	**Distribution by forms of education**, *hours*			
		Full-time		**Part-time**	
		Classes (C)	Individual work (IW)	Classes (C)	Individual work (IW)
lecture	45	16	29	-	-
practical	-	-	-		
laboratory	45	16	29	-	-
workshops	-	-	-		
TOGETHER	90	32	58	-	-

5 DISCIPLINE PROGRAM BY TYPES OF CLASSES

Ciphers DRN	**Types and topics of training sessions**	
	LECTURES	**45**
ПР07.1-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.	

Ciphers DRN	Types and topics of training sessions	
	LABORATORY CLASSES	**45**
ПР07.2-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 KNOWLEDGE PROGRESS TESTING

Certification of student achievement is accomplished through transparent procedures based on objective criteria in accordance with the University Regulations "On Evaluation of Higher Education Applicants' Learning Outcomes".

The level of competencies achieved in relation to the expectations, identified during the control activities, reflects the real result of the student's study of the discipline.

6.1 Grading Scales

Assessment of academic achievement of students of the Dnipro University of Technology is carried out based on a rating (100-point) and institutional grading scales. The latter is necessary (in the official absence of a national scale) to convert (transfer) grades for mobile students.

The scales of assessment of learning outcomes of the NTUDP students

Rating	Institutional
90 ... 100	Excellent
74 ... 89	Good
60 ... 73	Satisfactory
0 ... 59	Failed

Discipline credits are scored if the student has a final grade of at least 60 points. A lower grade is considered to be an academic debt that is subject to liquidation in accordance with the Regulations on the Organization of the Educational Process of NTUDP.

6.2 Diagnostic Tools and Evaluation Procedures

The content of diagnostic tools is aimed at controlling the level of knowledge, skills, communication, autonomy, and responsibility of the student according to the requirements of the National Qualifications Framework (NQF) up to the 6th qualification level during the demonstration of the learning outcomes regulated by the work program.

During the control activities, the student should perform tasks focused solely on the demonstration of disciplinary learning outcomes (Section 2).

Diagnostic tools provided to students at the control activities in the form of tasks for the intermediate and final knowledge progress testing are formed by specifying the initial data and a way of demonstrating disciplinary learning outcomes.

Diagnostic tools (control tasks) for the intermediate and final knowledge progress testing are approved by the appropriate department.

Type of diagnostic tools and procedures for evaluating the intermediate and final knowledge progress testing are given below.

Diagnostic and assessment procedures

<table>
<tr><th colspan="3">INTERMEDIATE CONTROL</th><th colspan="2">FINAL ASSESSMENT</th></tr>
<tr><th>training sessions</th><th>diagnostic tools</th><th>procedures</th><th>diagnostic tools</th><th>procedures</th></tr>
<tr><td>lectures</td><td>control tasks for each topic</td><td>task during lectures</td><td rowspan="3">comprehensive reference work (CCW)</td><td rowspan="3">determining the average results of intermediate controls;

CCW performance during the examination at the request of the student</td></tr>
<tr><td rowspan="2">laboratory</td><td>control tasks for each topic</td><td>tasks during practical classes</td></tr>
<tr><td>or individual task</td><td>tasks during independent work</td></tr>
</table>

During the intermediate control, the lectures are evaluated by determining the quality of the performance of the control specific tasks. Practical classes are assessed by the quality of the control or individual task.

If the content of a particular type of teaching activity is subordinated to several descriptors, then the integral value of the assessment may be determined by the weighting coefficients set by the lecturer.

Provided that the level of results of the intermediate controls of all types of training at least 60 points, the final control can be carried out without the student's immediate participation by determining the weighted average value of the obtained grades.

Regardless of the results of the intermediate control, every student during the final knowledge progress testing has the right to perform the CDF, which contains tasks covering key disciplinary learning outcomes.

The number of specific tasks of the CDF should be consistent with the allotted time for completion. The number of CDF options should ensure that the task is individualized.

The value of the mark for the implementation of the CDF is determined by the average evaluation of the components (specific tasks) and is final.

The integral value of the CDF performance assessment can be determined by taking into account the weighting factors established by the department for each NLC descriptor.

6.3 Evaluation Criteria

The actual student learning outcomes are identified and measured against what is expected during the control activities using criteria that describe the student's actions to demonstrate the achievement of the learning outcomes.

To evaluate the performance of the control tasks during the intermediate control of lectures and practicals the assimilation factor is used as a criterion, which automatically adapts the indicator to the rating scale:

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

where a - number of correct answers or significant operations performed according to the solution standard; m - the total number of questions or substantial operations of the standard.

Individual tasks and complex control works are expertly evaluated using criteria that characterize the ratio of competency requirements and evaluation indicators to a rating scale.

The content of the criteria is based on the competencies identified by the NLC for the Bachelor's level of higher education (given below).

General criteria for achieving learning outcomes

for the 6th qualification level for NQF (bachelor)

descriptors NLC	**Requirements for knowledge, communication, autonomy and responsibility**	**Indicator evaluation**
Knowledge		
♦ Conceptual knowledge acquired during the training and professional activities, including some knowledge of modern achievements; ♦ critical understanding of the main theories, principles, methods, and concepts in	- A great - proper, reasonable, sensible. Measures the presence of: - conceptual knowledge; - a high degree of state ownership issues; - critical understanding of the main theories, principles, methods and concepts in education and careers	95-100
	A non-gross contains mistakes or errors	90-94
	The answer is correct but has some inaccuracies	85-89
	A correct some inaccuracies but has also proved insufficient	80-84
	The answer is correct but has some inaccuracies, not reasonable and meaningful	74-79
	A fragmentary	70-73

descriptors NLC	Requirements for knowledge, communication, autonomy and responsibility	Indicator evaluation
education and careers	A student shows a fuzzy idea of the object of study	65-69
	Knowledge minimally satisfactory	60-64
	Knowledge unsatisfactory	<60
Ability		
♦ solving complex problems and unforeseen problems in specialized areas of professional and/or training, which involves the collection and interpretation of information (data), choice of methods and tools, the use of innovative approaches	- The answer describes the ability to: - identify the problem; - formulate hypotheses; - solve problems; - choose adequate methods and tools; - collect and interpret logical and understandable information; - use innovative approaches to solving the problem	95-100
	The answer describes the ability to apply knowledge in practice with no blunders	90-94
	The answer describes the ability to apply knowledge in practice but has some errors in the implementation of a requirement	85-89
	The answer describes the ability to apply knowledge in practice but has some errors in the implementation of the two requirements	80-84
	The answer describes the ability to apply knowledge in practice but has some errors in the implementation of the three requirements	74-79
	The answer describes the ability to apply knowledge in practice but has some errors in the implementation of the four requirements	70-73
	The answer describes the ability to apply knowledge in practice while performing tasks on the model	65-69
	A characterizes the ability to apply knowledge in performing tasks on the model, but with uncertainties	60-64
	The level of skills is poor	<60
Communication		
♦ report to specialists and non-specialists of information, ideas, problems, solutions and their experience in the field of professional activity; ♦ the ability to form an effective communication strategy	- Fluent problematic area. Clarity response (report). Language - correct; - - net; - - clear; - - accurate; - - logic; - - expressive; - - concise. Communication strategy: coherent and consistent development of thought; availability of own logical reasoning; relevant arguments and its compliance with the provisions defended; the correct structure of the response (report); correct answers to questions; appropriate equipment to answer questions;	95-100

descriptors NLC	Requirements for knowledge, communication, autonomy and responsibility	Indicator evaluation
	the ability to draw conclusions and formulate proposals	
	Adequate ownership industry issues with minor faults. Sufficient clarity response (report) with minor faults. Appropriate communication strategy with minor faults	90-94
	Good knowledge of the problems of the industry. Good clarity response (report) and relevant communication strategy (total three requirements are not implemented)	85-89
	Good knowledge of the problems of the industry. Good clarity response (report) and relevant communication strategy (a total of four requirements is not implemented)	80-84
	Good knowledge of the problems of the industry. Good clarity response (report) and relevant communication strategy (total not implemented the five requirements)	74-79
	Satisfactory ownership issues of the industry. Satisfactory clarity response (report) and relevant communication strategy (a total of seven requirements not implemented)	70-73
	Partial ownership issues of the industry. Satisfactory clarity response (report) and communication strategy of faults (total not implemented nine requirements)	65-69
	The fragmented ownership issues of the industry. Satisfactory clarity response (report) and communication strategy of faults (total not implemented 10 requirements)	60-64
	The level of poor communication	<60
Autonomy and responsibility		
♦ management actions or complex projects, responsible for decision-making in unpredictable conditions; ♦ responsible for the professional development of individuals and/or groups ♦ the ability to continue study with a high degree of autonomy	- Excellent individual ownership management competencies focused on: 1) management of complex projects, providing: - exploratory learning activities marked the ability to independently evaluate various life situations, events, facts, detect and defend a personal position; - the ability to work in a team; - control of their own actions; 2) responsibility for decision-making in unpredictable conditions, including: - justify their decisions the provisions of the regulatory framework of sectoral and national levels; - independence while performing tasks; - lead in discussing problems; - responsibility for the relationship; 3) responsible for the professional development of individuals and/or groups that includes: - use of vocational-oriented skills; - the use of evidence from independent and correct reasoning; - possession of all kinds of learning activities; 4) the ability to further study with a high degree of autonomy, which provides: - degree possession of fundamental knowledge; - independent evaluation judgments;	95-100

descriptors NLC	Requirements for knowledge, communication, autonomy and responsibility	Indicator evaluation
	- high level of formation of general educational skills; - search and analysis of information resources	
	Confident personality possession competency management (not implemented two requirements)	90-94
	Good knowledge management competencies personality (not implemented three requirements)	85-89
	Good knowledge management competencies personality (not implemented the four requirements)	80-84
	Good knowledge management competencies personality (not implemented six requirements)	74-79
	Satisfactory ownership of individual competence management (not implemented seven requirements)	70-73
	Satisfactory ownership of individual competence management (not implemented eight claims)	65-69
	The level of autonomy and responsibility fragmented	60-64
	The level of autonomy and responsibility poor	<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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