**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE**

**Dnipro University of Technology**

## Department of Electrical Engineering

«ЗАТВЕРДЖЕНО»
Завідувач кафедри
Ципленков Д.В. _____
«31» 08 2021 року

# EDUCATIONAL DISCIPLINE WORK PROGRAM

## «Theoretical foundations of electrical engineering»

| | |
|---|---|
| Knowledge area ……..…… | 14 Electrical Engineering |
| Specialty ……..... | 141 Electrical energetics, electrical engineering and electromechanics |
| Level of higher education ……... | second (master's degree) |
| Degree …… | bachelor |
| Educational and professional program … | Electrical energetics, electrical engineering and electromechanics |
| Specialization …….. | – |
| Status …….. | normative |
| Total of hours (credits)..…….. | 9 credits ECTS (270 hours) |
| Form of final control …….. | Exam |
| Term of teaching ….…… | 2, 3 and 4 semesters |
| Language of instruction …….. | English |

Lecturer: Doctor of Technical Sciences, Professor Khilov V.S.

Prolonged: to 20__/20__ s.y. _____ (_____) «__»____ 20__y.
(підпис, ПІБ, дата)

to 20__/20__ s.y. _____ (_____) «__»____ 20__y.
(підпис, ПІБ, дата)

to 20__/20__ s.y. _____ (_____) «__»____ 20__y.
(підпис, ПІБ, дата)

Dnipro
Dnipro University of Technology
2021

Working program of the normative educational discipline "Theoretical foundations of electrical engineering" for bachelors speciality in 141 "Electrical energetics, electrical engineering and electromechanics" / Dnipro University of Technology, Department of Electrical Engineering. - D.: Dniprotech, 2021. - 19 p.

Developer – Doctor of Technical Sciences, Professor Khilov V.S.

The work program regulates:

– the purpose of the discipline;
– disciplinary learning outcomes formed on the basis of the transformation of the expected learning outcomes of the educational program;
– basic disciplines;
– the amount and distribution of forms of organization of the educational process and types of training sessions;
– program of the discipline (thematic plan by types of classes);
– algorithm for assessing the level of achievement of disciplinary learning outcomes (scales, tools, procedures and evaluation criteria);
– tools, equipment and software;
– recommended sources of information.

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

Agreed by the decision of the scientific-methodical commission of the specialty 141 Electrical energetics, electrical engineering and electromechanics (protocol № 21/22-01 from 30.08.2021).

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## 1 THE PURPOSE OF THE EDUCATION DISCIPLINE

In the educational-professional program of the Dnipro University of Technology specialty 141 "Electrical energetics, electrical engineering and electromechanics" the distribution of program learning outcomes by organizational forms of educational process. In particular, the discipline Б5 "Theoretical foundations of electrical engineering" includes the following learning outcomes:

| **Code ПРН** | **Learning outcomes** |
|---|---|
| ПР05 | Know the basics of the theory of the electromagnetic field, methods of calculating electric circuits and be able to use them to solve practical problems in professional activities. |

**The purpose of the discipline** is to form in future professionals competencies in the field of normative-basic discipline "Theoretical foundations of electrical engineering".

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 EXPECTED DISCIPLINARY LEARNING OUTCOMES

| **Code ПРН** | **Disciplinary learning outcomes (DLO)** | |
|---|---|---|
| | **Code ДРН** | **content** |
| ПР05 | ПР05.1- Б5 | Calculation methods of linear DC circuits at steady state mode. |
| | ПР05.2- Б5 | Linear circuits of single-phase current at steady state mode |
| | ПР05.3- Б5 | Magnetically coupled linear circuits of single-phase current in a steady-state mode |
| | ПР05.4- Б5 | Linear circuits of three-phase current in steady-state mode |
| | ПР05.5- Б5 | Linear circuits of polyharmonic current in steady state mode |
| | ПР05.6- Б5 | Classical and operator methods of analysis of transients in linear circles with lumped parameters |
| | ПР05.7- Б5 | Nonlinear DC and AC circuits in steady state mode |
| | ПР05.8- Б5 | Analysis methods of transients in nonlinear circuits |
| | ПР05.9- Б5 | Fundamentals of the theory of two-port circuits |
| | ПР05.10- Б5 | Passive reactive filters |
| | ПР05.11- Б5 | Circles with distributed parameters |
| | ПР05.12- Б5 | Electrostatic field in a dielectric medium |
| | ПР05.13- Б5 | The magnetic field of direct current |
| | ПР05.14- Б5 | Alternating electromagnetic field in a stationary medium |

## 3 BASIC DISCIPLINES

| Discipline name | Learning outcomes obtained |
|---|---|
| 33 Foreign language for professional purposes (English, German, French) | ПР11 Communicate freely on professional issues in state and foreign languages orally and in writing, discuss the results of professional activities with specialists and non-specialists, argue their position on debatable issues |
| Б1 Higher mathematics<br>Б2 General Physics | ПР07 Carry out analysis of processes in electrical, electrical and electromechanical equipment, relevant complexes and systems. |
| | ПР08 Select and apply suitable methods for analysis and synthesis of electromechanical and electrical systems with specified parameters. |
| Б3 Computer science | ПР06 Apply application software, microcontrollers and microprocessor technology to solve practical problems in professional activities |
| | ПР18 Be able to learn independently, acquire new knowledge and improve skills in working with modern equipment, measuring equipment and application software. . |

## 4 AMOUNT AND DISTRIBUTION BY FORMS OF ORGANIZATION OF THE EDUCATIONAL PROCESS AND TYPES OF EDUCATIONAL 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 | 128 | 104 | 24 | | | 128 | 18 | 110 |
| practical | 63 | 24 | 39 | | | 142 | 16 | 126 |
| laboratory | 79 | 53 | 26 | | | | | |
| seminars | - | - | - | | | | | |
| Total | 270 | 181 | 89 | | | 270 | 34 | 236 |

## 5 DISCIPLINE PROGRAM BY TYPES OF EDUCATIONAL CLASSES

| Code ДРН | Types and topics of training sessions | Volume of components, hours |
|---|---|---|
| ПР05.1- Б5<br>ПР05.2- Б5<br>ПР05.3- Б5<br>ПР05.4- Б5<br>ПР05.5- Б5<br>ПР05.6- Б5<br>ПР05.7- Б5<br>ПР05.8- Б5<br>ПР05.9- Б5 | **Lectures** | 128 |
| | 1. Linear DC circuits at steady state mode | 14 |
| | 1.1. Introduction. Current, voltage, power, resistance, conductivity | |
| | 1.2. Voltage and current sources | |
| | 1.3. Dropping voltage across the section of the circle. Ohm's law. | |
| | 1.4. Power balance in an electric DC circuit. | |
| | 1.5. Methods for calculating resistive circuits. | |
| | 1.6. Conclusions | |

| | | |
|---|---|---|
| ПР05.10- Б5<br>ПР05.11- Б5<br>ПР05.12- Б5<br>ПР05.13- Б5<br>ПР05.14- Б5 | 2. Linear circuits of single-phase current at steady state mode | 14 |
| | 2.1. Harmonic oscillations | |
| | 2.2. Instant, average and rms value of harmonic voltages and currents | |
| | 2.3. Representation of harmonic functions by vectors and complex numbers | |
| | 2.4. Harmonic oscillations in elementary resistive, inductive and capacitive circuits | |
| | 2.5. Harmonic oscillations in series-connected RLC elements | |
| | 2.6. Harmonic oscillations in parallel-connected RLC elements | |
| | 2.7. Phase calculation method for branched circles with harmonic oscillations | |
| | 2.8. Power balance in an AC circuit. | |
| | 2.9. Resonance in AC electrical circuits. | |
| | 2.10. Conclusions | |
| | 3. Magnetically coupled linear circuits of single-phase current in a steady-state mode | 9 |
| | 3.1. The phenomenon of mutual inductance. Coefficient of mutual induction. | |
| | 3.2. Series connection of magnetically coupled coils | |
| | 3.4. Parallel connection of magnetically coupled coils | |
| | 3.5. Methods for calculating circles with magnetically coupled elements | |
| | 3.6. Power balance in circles with magnetically coupled elements. | |
| | 3.7. Conclusions | |
| | 4. Linear circuits of three-phase current in constant mode | 9 |
| | 4.1. Multiphase electric circuits | |
| | 4.2. Wye connection in three-phase circuits | |
| | 4.3. Delta connection in three-phase circuits | |
| | 4.4. Power balance in three-phase circuits. Power measurement of a three-phase circuit. | |
| | 4.5. Method of symmetrical components | |
| | 4.6. Conclusions | |
| | 5. Linear circuits of polyharmonic current in steady state mode | 9 |
| | 5.1. Representation of polyharmonic currents and voltages by Fourier series | |
| | 5.2. Calculation of circuits in the presence of polyharmonic currents and voltages sources | |
| | 5.3. The rms value of polyharmonic currents and voltages | |
| | 5.4. Power balance in circuits with polyharmonic currents and voltages | |
| | 5.5. Resonance in electrical circuits with polyharmonic currents and voltages | |
| | 5.6. Polyharmonic currents and voltages in three-phase circuits | |
| | 5.7. Conclusions | |
| | 6. Classical and operator methods of analysis of transients in linear circles with lumped parameters | 13 |

| | | |
|---|---|---|
| | 6.1. The emergence of transients | |
| | 6.2. Laws of switching in electric circuits | |
| | 6.3. Transients, forced and natural processes in electrical circuits | |
| | 6.4. Definition of the characteristic equation | |
| | 6.5. Definition of integration constants | |
| | 6.6. The order of calculation by the classical method of transients | |
| | 6.6.1. Analysis of transients in linear circuits by the classical method with one and two energy storage devices | |
| | 6.7. Analysis of transients in linear circles by the operator method | |
| | 6.7.1. Conversion originals to images | |
| | 6.7.2. Laws of electric circuits in operator form | |
| | 6.7.2. Calculation of operator equvalent circuits | |
| | 6.7.3. The order of calculation by the operator method of transients | |
| | 6.7.4. Analysis of transients in linear circles by the operator method | |
| | 6.7.5. Conversion images to originals | |
| | 6.8. Calculation of the response of the circle to the signal of any shape | |
| | 6.8.1. Using the Duhamel integral when connecting a circuit to a signal of arbitrary shape | |
| | 6.9. Conclusions | |
| | 7. Nonlinear DC circuits in steady state mode | 8 |
| | 7.1. Graphical representation of volt-ampere characteristics of nonlinear elements | |
| | 7.2. Static and dynamic resistances of nonlinear elements | |
| | 7.3. Calculation of nonlinear circuits with series, parallel and mixed connection of elements | |
| | 7.4. Calculation of electrical circuits by the method of equivalent generator | |
| | 7.5. Calculation of electrical circuits by the method of two nodes | |
| | 7.6. Conclusions | |
| | 8. Nonlinear AC circuit in steady state mode | 8 |
| | 8.1. Features of periodic processes in nonlinear circuits with inertial elements | |
| | 8.2. Coil with a steel cell powered by a harmonic voltage source. Equivalent harmonic currents and voltages | |
| | 8.3. Equivalent circuit and vector diagram of coils with steel core | |
| | 8.4. Ferroresonance phenomenon | |
| | 8.5. Ferroresonant voltage stabilizers, magnetic power amplifiers, harmonic ferromagnetic separators | |
| | 8.6. Features of the analysis of circuits with semiconductor diodes | |
| | 8.7. Conclusions | |

| | | |
|---|---|---|
| | 9. Analysis methods of transients in nonlinear circuits | 8 |
| | 9.1. Stability of operation mode of nonlinear circles | |
| | 9.2 Method of piecewise-linear approximation of the self-oscillating circle | |
| | 9.3. Methods for calculating transients in a coil with a steel core | |
| | 9.4. Representation of transients in the phase plane | |
| | 9.5. Conclusions | |
| | 10. Fundamentals of the theory of two-port circuits | 9 |
| | 10.1. The equation of two-port circuits | |
| | 10.2. Modes of open and short circuit of two-port circuits | |
| | 10.3. Determining the parameters of two-port circuits | |
| | 10.4. Matched impedance and propagation coefficient of symmetric two-port circuits | |
| | 10.5. Two-port circuits transfer functions and feedback | |
| | 10.6. Conclusions | |
| | 11. Passive reactive filters | 9 |
| | 11.1 Basic properties of reactive filters | |
| | 11.2. Frequency characteristics of filters | |
| | 11.3. Low frequency filters | |
| | 11.4. High frequency filters | |
| | 11.5. Band pass filters | |
| | 11.6. Band stop filters | |
| | 11.7. Conclusions | |
| | 12. Circles with distributed parameters | |
| | 12.1. Lumped and distributed parameters of electrical circuits | 9 |
| | 12.2. Equation of a homogeneous line | |
| | 12.3. Solving homogeneous line equations in stationary modes | |
| | 12.4. Running and standing waves | |
| | 12.4. Voltage and current distribution along a long line | |
| | 12.5. Transients in homogeneous lines | |
| | 12.6. Conclusions | |
| | 13. Electrostatic field in a dielectric medium | 4 |
| | 13.1. Vortex-free nature of the electrostatic field | |
| | 13.2. Gauss's theorem | |
| | 13.3. Poisson and Laplace equations | |
| | 13.4. Boundary conditions | |
| | 13.5. Electrostatic field energy density | |
| | 13.6. Elementary electrostatic fields | |
| | 13.7. Conclusions | |
| | 14. The magnetic field of direct current | 4 |
| | 14.1. The law of total current. Scalar magnetic potential | |
| | 14.1. Vector magnetic potential | |
| | 14.2. Boundary conditions | |
| | 14.3. Magnetic field energy density | |
| | 14.4. Elementary magnetic fields | |
| | 14.5. Conclusions | |
| | 15. Alternating electromagnetic field in a stationary | 4 |

| | | |
|---|---|---|
| | medium | |
| | 15.1. Displacement current | |
| | 15.2. Maxwell's equation | |
| | 15.3. Poiting's theorem | |
| | 15.4. Flat waves in a homogeneous dielectric | |
| | 15.5. Conclusions | |
| ПР05.1- Б5 | **Laboratory classes** | 79 |
| ПР05.2- Б5 | 1. Linear DC circuits in steady state mode | 10 |
| ПР05.3- Б5 | Research of a branched circle by the method of trans- | |
| ПР05.4- Б5 | formations | |
| ПР05.5- Б5 | Power transmission from active to passive one-port | |
| ПР05.6- Б5 | circuits | |
| ПР05.7- Б5 | 2. Linear circuits of single-phase current in steady state | 10 |
| ПР05.8- Б5 | mode | |
| ПР05.9- Б5 | Series connection of elements | |
| ПР05.10- Б5 | Parallel connection of elements | |
| ПР05.11- Б5 | Series resonance | |
| ПР05.12- Б5 | Parallel resonance | |
| ПР05.13- Б5 | 3. Magnetically coupled linear circuits of single-phase | 6 |
| ПР05.14- Б5 | current in steady state mode | 8 |
| | Series and parallel connection of magnetically coupled coils | |
| | 4. Linear circuits of three-phase current in steady state mode | |
| | Symmetrical three-phase source and symmetrical load connected in a symmetrical and asymmetrical wye | |
| | Symmetrical three-phase source and symmetrical load connected in a symmetrical and asymmetrical delta | |
| | Asymmetric three-phase source and symmetrical load connected to a symmetrical wye | |
| | 5. Linear circuits of polyharmonic current in steady state mode | 10 |
| | Polyharmonic currents and voltages in single-phase circuits | |
| | Polyharmonic currents and voltages in three-phase cir- cuits | |
| | 6. Classical and operator methods of analysis of transi- ents in linear circles with lumped parameters | 12 |
| | Transients in the resistive-inductive circuit | |
| | Transients in the resistive-capacitive circuit | |
| | The discharge of the capacitor on the resistive-inductive circuit | |
| | 7. Nonlinear DC circuits in steady state mode | 5 |
| | Branched nonlinear DC circuit | |
| | 8. Nonlinear alternating current circuits in steady state mode | 5 |
| | Inductor with steel core on alternating current | |
| | 9. Methods of analysis of transients in nonlinear circles | 5 |
| | Self-oscillation in a nonlinear circle | |
| | 10. Fundamentals of the theory of two-port circuits | 5 |
| | Parameters of an asymmetric two-port circuits | |

| | | |
|---|---|---|
| | 12. Circles with distributed parameters | 5 |
| | Homogeneous long line | |
| | 13. Electrostatic field in a dielectric medium | 5 |
| | Electrostatic field modeling | |
| | 14. The magnetic field of direct current | 5 |
| | Magnetic field around a current-carrying conductor | |
| ПР05.1- Б5<br>ПР05.2- Б5<br>ПР05.3- Б5<br>ПР05.4- Б5<br>ПР05.5- Б5<br>ПР05.6- Б5<br>ПР05.7- Б5<br>ПР05.8- Б5<br>ПР05.9- Б5<br>ПР05.10- Б5<br>ПР05.11- Б5<br>ПР05.12- Б5<br>ПР05.13- Б5<br>ПР05.14- Б5 | **PRACTICAL TRAINING** | 63 |
| | 1. Linear DC circuits in steady state mode | |
| | 2. Linear circuits of single-phase current in steady state mode | |
| | 3. Magnetically coupled linear circuits of single-phase current in steady state mode | |
| | 4. Linear circuits of three-phase current in steady state mode | |
| | 5. Linear circuits of polyharmonic current in steady state mode | |
| | 6. Classical and operator methods of analysis of transi-ents in linear circles | |
| | 7. Nonlinear DC circuits in steady state mode | |
| | 8. Nonlinear alternating current circuits in steady state mode | |
| | 9. Fundamentals of the theory of two-port circuits | |
| | 10. Passive reactive filters | |
| | 11. Circles with distributed parameters in steady state modes | |
| | **TOTAL** | 270 |

## 6 EVALUATION OF LEARNING OUTCOMES

Certification of student achievement is carried out through transparent procedures based on objective criteria in accordance with the Regulations of the University "On the evaluation of learning outcomes of higher education."

The achieved level of competencies relative to the expected ones, which is identified during the control activities, reflects the real result of the student's study in the discipline.

### 6.1 Scales

Assessment of academic achievements of students of Dnipro University of Technology is carried out on a rating (100-point) and conversion scales. The latter is necessary (in the official absence of a national scale) for the conversion (translation) of grades of higher education students of different institutions.

***Scales for assessing the academic achievements of DNIPROTECH students***

| Rating | Conversion |
|---|---|
| 90…100 | відмінно / Excellent |
| 74…89 | добре / Good |
| 60…73 | задовільно / Satisfactory |
| 0…59 | незадовільно / Fail |

Credits of the discipline is accounted if the student received a final mark of at least 60 points. The lower mark 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 DniproTECH.

### 6.2 Means and 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 HPK to the 7th qualification level during the demonstration of learning outcomes regulated by the work program.

The student in the control activities must perform tasks focused solely on the demonstration of disciplinary learning outcomes (Section 2).

Diagnostic tools provided to students at control activities in the form of tasks for current and final control, are formed by specifying the initial data and the method of demonstrating disciplinary learning outcomes.

Diagnostic tools (control tasks) for the current and final control of the discipline are approved by the department.

The types of diagnostic tools and assessment procedures for the current and final control of the discipline are given below.

***Diagnostic tools and assessment procedures***

| **CURRENT CONTROL** | | | **FINAL CONTROL** | |
|---|---|---|---|---|
| **training session** | **diagnostic tools** | **procedures** | **diagnostic tools** | **procedures** |
| Lectures | control tasks for each topic | performing the task during lectures | complex control work (CCW) | determination of the weighted average result of current controls;<br><br>performing CCW during the exam at the request of the student |
| Practical lessons | control tasks for each topic or individual task | performing tasks during practical classes | | |
| Laboratory lessons | control tasks for each topic or individual task | performing tasks during practical classes | | |

During the current control, lectures are evaluated by determining the quality of control specific tasks. Laboratory classes and practical lessonsare evaluated by the quality of the control or individual task.

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<br>- conceptual knowledge<br>- high level mastering the state of the matter<br>- critical comprehension the main theories, principles, methods, and concepts in the field of learning and professional activity. | 95-100 |

| Description qualification equal | Requirements to knowledge, skills/abilities, communications, responsibility, and autonomy | Score values |
|---|---|---|
| | 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 |
| | 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:<br>- identify problems<br>- formulate hypotheses<br>- solve problems<br>- choose adequate methods and tools<br>- collect and logically and clearly interpret information<br>- 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 |

| Description qualification equal | Requirements to knowledge, skills/abilities, communications, responsibility, and autonomy | Score values |
|---|---|---|
| | ***Communication*** | |
| ♦ reporting to specialists and non-specialists information, ideas, problems, solutions, personal experience, and argumentation<br>♦ collection, interpretation, and application of data<br>♦ communication on professional issues, including in a foreign language, orally and in writing | Free possession of industry issues.<br>Clarity of the answer (report). Language:<br>- correct<br>- clean<br>- clear<br>- accurate<br>- logical<br>- expressive<br>- concise.<br>Communication strategy:<br>- consistent and consistent development of thought<br>- the presence of logical own judgments<br>- relevant reasoning and its compliance with the defended provisions<br>- correct structure of the answer (report)<br>- correct answers to questions<br>- appropriate technique for answering questions<br>- ability to draw conclusions and formulate proposals | 95-100 |
| | Sufficient mastery of industry issues with minor flaws.<br>Sufficient clarity of the answer (report) with minor errors.<br>Appropriate communication strategy with minor flaws | 90-94 |
| | Good mastery of industry issues.<br>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.<br>Good clarity of response (report) and appropriate communication strategy (four requirements not implemented in total) | 80-84 |
| | Good mastery of industry issues.<br>Good clarity of response (report) and appropriate communication strategy (five requirements not implemented in total) | 74-79 |
| | Satisfactory mastery of industry issues.<br>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.<br>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.<br>Satisfactory comprehensibility of the answer (report) and communication strategy with errors (a total of 10 requirements are not implemented) | 60-64 |

| Description qualification equal | Requirements to knowledge, skills/abilities, communications, responsibility, and autonomy | Score values |
|---|---|---|
| | The level of communication is unsatisfactory | <60 |
| | ***Responsibility and autonomy*** | |
| ♦ managing complex technical or professional activities or projects<br>♦ ability to take responsibility for making and approvement decisions in unpredictable work and / or learning contexts<br>♦ formation of judgments that consider social, scientific and ethical aspects<br>♦ organization and management of professional development of individuals and groups<br>♦ ability to continue studies with a significant degree of autonomy | Excellent mastery of personal management competencies focused on:<br>1) management of complex projects, which provides:<br>- research nature of educational activities, marked by the ability to independently assess various life situations, phenomena, facts, to identify and defend a personal position<br>- ability to work in a team<br>- control of own actions<br>2) responsibility for making decisions in unpredictable conditions, including:<br>- substantiation of own decisions by provisions of normative base of branch and state levels<br>- independence in performing tasks<br>- initiative in discussing problems<br>- responsibility for the relationship<br>3) responsibility for professional development of individuals and / or groups of persons, which includes:<br>- use of professional-oriented skills<br>- use of evidence with independent and correct argumentation<br>- mastery of all types of educational activities<br>4) the ability to further study with a high level of autonomy, which includes:<br>- degree of possession of fundamental knowledge<br>- independence of evaluative judgments<br>- high level of formation of general educational skills and abilities<br>- independent search and analysis of information sources | 95-100 |
| | 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) | Work title | Tools, equipment and software used in the work |
|---|---|---|
| TFEE-1 | Linear DC circuits in steady state mode. Research of a branched circle by the method of transformations | Study-research laboratory stand УЛС-2, multimeter, oscilloscope |
| TFEE-2 | Linear DC circuits in steady state mode. Power transmission from active to passive two-port circuits | Study-research laboratory stand УЛС-2, multimeter, oscilloscope |
| TFEE-3 | Linear circuits of single-phase AC in steady state mode. Series connection of elements, voltage resonance. | Study-research laboratory stand УЛС-2, multimeter, oscilloscope |
| TFEE-4 | Linear circuits of single-phase AC in steady state mode. Parallel connection of elements, resonance of currents. | Study-research laboratory stand УЛС-2, multimeter, oscilloscope |
| TFEE-5 | Linear circuits of single-phase AC in steady state mode. Magnetically coupled linear circuits of single-phase current in steady state mode. | Study-research laboratory stand УЛС-2, multimeter, oscilloscope |
| TFEE-6 | Linear circuits of three-phase current AC in steady state mode. Symmetrical three-phase source and symmetrical load connected in a symmetrical delta and asymmetrical wye | Study-research laboratory stand УЛС-2, multimeter, oscilloscope |
| TFEE-7 | Linear circuits of three-phase current AC in steady state mode. A symmetrical three-phase source and asymmetrical load connected in delta and wye. | Study-research laboratory stand УЛС-2, multimeter, oscilloscope |
| TFEE-8 | Linear circuits of three-phase current in steady state mode. Asymmetric three-phase source and symmetrical load connected to a symmetrical wye | Study-research laboratory stand УЛС-2, multimeter, oscilloscope |
| TFEE-9 | Linear circuits of polyharmonic current in steady state. Polyharmonic currents and voltages in single-phase circuits. | Study-research laboratory stand УЛС-2, multimeter, oscilloscope |
| TFEE-11 | Linear circuits polyharmonic Polyharmonic currents and voltages in three-phase circuits th current in steady state. | Study-research laboratory stand УЛС-2, multimeter, oscilloscope |
| TFEE-13 | Classical and operator methods of analysis of transients in linear circles with concentrated parameters. Transients in the resistive-inductive circuit | Study-research laboratory stand УЛС-2, multimeter, oscilloscope |
| TFEE-14 | Classical and operator methods of analysis of transients in linear circles with concentrated parameters. Transients in the resistive-capacitive circuit. | Study-research laboratory stand УЛС-2, multimeter, oscilloscope |
| TFEE-15 | Classical and operator methods of analysis of transients in linear circles | Study-research laboratory stand УЛС-2, multimeter, oscilloscope |

| | | |
|---|---|---|
| | with concentrated parameters. The discharge of the capacitor on the resistive-inductive circuit | |
| TFEE-16 | Self-oscillation in a nonlinear circle | Study-research laboratory stand УІЛС-2, multimeter, oscilloscope |
| TFEE-17 | Parameters of an asymmetric quadrupole | Study-research laboratory stand УІЛС-2, multimeter, oscilloscope |
| TFEE-18 | Homogeneous long line | Study-research laboratory stand УІЛС-2, multimeter, oscilloscope |
| TFEE-19 | Electrostatic field modeling | Study-research laboratory stand УІЛС-2, multimeter, oscilloscope |
| TFEE-20 | Magnetic field around a current-carrying conductor | Study-research laboratory stand УІЛС-2, multimeter, oscilloscope |

## 8. RECOMMENDED SOURCES OF INFORMATION


1 Khilov V.S. Theoretical fundamentals of electric engineering. Підручник. / В. С. Хілов – Д., 2018. – 467 с.

2 Теоретичні основи електротехніки. Електричні кола: навч. посібник / В.С. Маляр. – Львів: Видавництво Львівської політехніки, 2012. – 312 с.

3 Теоретичні основи електротехніки. Усталені режими лінійних електричних кіл із зосередженими та розподіленими параметрами : підручник / Ю. О. Карпов, С. Ш. Кацив, В. В. Кухарчук, Ю. Г. Ведміцький ; під ред. проф. Ю. О. Карпова – Вінниця : ВНТУ, 2011. – 377 с.

4 Теоретичні основи електротехніки: Частина 1. Електричні кола постійного та змінного струму. Чотириполюсники [Електронний ресурс]: навч. посіб. для студ. спеціальності 141 «Електроенергетика, електротехніка та електромеханіка»/ КПІ ім. Ігоря Сікорського; уклад.: Ю. В. Перетятко, А. А. Щерба– Електронні текстові дані (1 файл: 21.7 Мбайт). – Київ : КПІ ім. Ігоря Сікорського, 2021. – 115 с

5 Овчаров В.В. Теоретичні основи електротехніки, частина 1. Мелітополь : Видавничо-поліграфічний центр «Люкс», 2007. 389 с.

6 Collection of methodical materials for laboratory work on discipline «Theoretical fundamentals of electrical engineering» for full-time students' majoring in 141 – Electric Power, Electrical Engineering and Electromechanical. Part 1 "Fundamentals of the theory of DC circuits"; "Fundamentals of the theory of harmonic single-phase currents" / V.S.Khilov; Dnipro University of Technology – D.: DniproTech, 2021. – 35 p.

7 Collection of methodical materials for laboratory work on discipline «Theoretical fundamentals of electrical engineering» for full-time students' majoring in 141 – Electric Power, Electrical Engineering and Electromechanical. Part 1 "Three-phase circuits", "Polyharmonic currents and voltages in single-phase and three-phase circuits", "Transients in linear electric circuits" / V.S.Khilov; Dnipro University of Technology – D.: DniproTech, 2021. – 52 p.

8 Collection of methodical materials for laboratory work on discipline «The-

oretical fundamentals of electrical engineering» for full-time students' majoring in 141 – Electric Power, Electrical Engineering and Electromechanical. Part 3 "Nonlinear electric circuits of direct and alternating currents", "Magnetic circuits", "Transients in circuits with nonlinear elements" / V.S.Khilov; Dnipro University of Technology – D.: DniproTech, 2021. – 30 p.

9 Collection of methodical materials for to independent and practical works on discipline «Theoretical fundamentals of electrical engineering» for full-time students' majoring in 141 – Electric Power, Electrical Engineering and Electromechanical. Part 1 «Theory fundamentals of dc and single-phase harmonic ac circuits» / V.S.Khilov; Dnipro University of Technology – D.: DniproTech, 2021. – 44 p.

10 Collection of methodical materials for to independent and practical works on discipline «Theoretical fundamentals of electrical engineering» for full-time students' majoring in 141 – Electric Power, Electrical Engineering and Electromechanical. Part 2 «Three–phase circuits, Polyharmonical voltages and currents in circuit, Transient analisis of a linear circuits» / V.S.Khilov; Dnipro University of Technology – D.: DniproTech, 2021. – 99 p.

11 Collection of methodical materials for to independent and practical works on discipline «Theoretical fundamentals of electrical engineering» for full-time students' majoring in 141 – Electric Power, Electrical Engineering and Electromechanical. Part 3 « DC and AC nonnlinear circuits, Magnetic circuits, Transients into circuits with nonlinear elements» / V.S.Khilov; Dnipro University of Technology – D.: DniproTech, 2021. – 35 p.

Working program
of the normative educational discipline
"**THEORETICAL FOUNDATIONS OF ELECTRICAL ENGINEERING**"
for bachelors speciality in 141 "Electrical energetics, electrical engineering and electromechanics"

Developer: Khilov V.S.

Edited by the author