MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
DNIPRO UNIVERSITY OF TECHNOLOGY

Educational Scientific Institute of Electric Power Engineering
The Department of Electric Power Engineering

«APPROVED»
Head of the Department
Papaika Yu.A._____.
31.08.2021

DISCIPLINE CURICULLUM
«Basics of electricity production, distribution and consumption»

Field of study ……..…	14 Electrical engineering
SPECIALTY ……...	141 Electric Power Engineering, Electrical Engineering and Electromechanics
Educational Level…….	First (bachelor)
Educational-Professional program	Electric Power Engineering, Electrical Engineering and Electromechanics
Status ……	compulsory
Total volume	6 credits ECTS (180 hours)
Form of final control	exam
Term of teaching	Fourth semester
Language of teaching	English

Lecturer: _Lutsenko I.M._____
Prolonged: for 2021/2022 a.y. _____(Papaika Yu.A.) «__»___ 20__year.
(signature, last name, first name, date)
for 20__/20__ a.y _____(_____) «__»___ 20__year.
(signature, last name, first name, date)

Dnipro
Dnipro University of Technology
2021

Discipline curriculum «Basics of electricity production, distribution and consumption» for Bachelor Speciality 141 «Electric Power Engineering, Electrical Engineering and Electromechanics» / I.M. Lutsenko / Dnipro University of Technology, the Department of Electric Power Engineering – Dnipro : DUT, 2020. – 13 p.

Authors:

Lutsenko Ivan Mykolaiovych, professor of the Department of Electric Power Engineering, Ph.D., tech., assistant professor;

The Curriculum regulates:

– Purpose of the discipline;
– Discipline learning outcomes formulated on the basis of curriculum's anticipated learning outcomes' transformation;
– Basic subjects;
– Volume and distribution by forms of organization of the educational process and types of training classes;
– Program of the discipline (thematic plan by types of training sessions);
– Algorithm for assessing the level of achievement of disciplinary learning outcomes (scales, tools, procedures and assessment criteria);
– Tools, equipment and software;
– Recommended sources of information.

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

Agreed by the decision of the scientific-methodical commission of the specialty 141 Electric Power Engineering, Electrical Engineering and Electromechanics (protocol № 21/22-01 from 30.08.2021).

CONTENT

1 PURPOSE OF THE COURSE

In the educational and professional program of the Dnipro University of Technology for specialty 141 "Electric Power Engineering, electrical engineering and electromechanics" the distribution of program learning outcomes (PLO) is done by organizational forms of the educational process. In particular, the following learning outcomes have been linked to discipline Ф5 " Basics of electricity production, distribution and consumption "

ПР01	Know and understand the principles of operation of electrical systems and networks, power equipment of power plants and substations, protective earthing and lightning protection devices and be able to use them to solve practical problems in professional activities
ПР04	Know the principles of bioenergy, wind, hydro and solar power plants
ПР13	Understand the importance of traditional and renewable energy for successful economic development of the country
ПР19	Apply suitable empirical and theoretical methods to reduce electricity losses during its production, transportation, distribution and use

The purpose of the discipline - the formation of competencies to determine the structure, analysis of modes of operation and basic technical means and solutions in the systems of production, distribution and consumption of electricity in Ukraine, promising areas of electricity industry, taking into account energy efficiency and energy saving.

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 of PLO	Disciplinary learning outcomes **(DLO)**	
	Code of DLO	**content**
ПР01	ПР01.01-Ф5	Know and understand the principles of operation of electrical systems and networks, power equipment of power plants and substations, protective earthing and lightning protection devices and be able to use them to solve practical problems in professional activities
ПР04	ПР04.01-Ф5	Know the principles of bioenergy, wind, hydro and solar power plants
ПР13	ПР13.01-Ф5	Understand the importance of traditional and renewable energy for successful economic development of the country
ПР19	ПР19.01-Ф5	Apply suitable empirical and theoretical methods to reduce electricity losses during its production, transportation, distribution and use

3. BASIC DISCIPLINES

Disciplines of the general training cycle

Discipline Name	Earning outcomes gained
General physics	ПР07.1-Б2 Know: basic laws and concepts of classical (including relativistic) and quantum mechanics, thermodynamics and statistical physics, electrodynamics, theory of oscillations and waves, physics of atoms, molecules, atomic nucleus and condensed state. ПР08.2-Б2 Formulate physical ideas, solve problems, estimate quantities, operate with physical models and understand the limits of their applications
Higher mathematics	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
Electric machinces	ПР03.2-Ф1 To assess working parameters of electric machines as part of electrical, electric power, and electromechanical equipment and relevant complexes and systems, and to develop measures of their energy efficiency and reliability improvement. ПР03.6-Ф1 To carry out new ways for solving problems of economic conversion, distribution, transmission, and application of electrical energy by means of electric machines.
Electrical materials	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
Fundamentals of electric engineering	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.

4. VOLUME AND DISTRIBUTION BY FORMS OF ORGANIZATION OF THE EDUCATIONAL PROCESS AND TYPES OF EDUCATIONAL CLASSES

Type of training sessions	Volume, hours	Distribution by forms of study, hours					
		Full-time		Part-time		extramural	
		Class work	Individual work	Class work	Individual work	Class work	Individual work
lectures	80	43	37	-	-	-	-
practical	50	8	42	-	-	-	-
laboratory	50	17	33	-	-	-	-
seminars	-	-	-	-	-	-	-
TOTAL	180	77	103	-	-	-	-

5 DISCIPLINE PROGRAM BY TYPES OF EDUCATIONAL CLASSES

Code of DLO	Types and topics of training sessions	Volume of components, *hours*
	Lectures	**80**
ПР13.01-Ф5	1 The current state of the electricity industry of Ukraine and the world	8
ПР04.01-Ф5, ПР13.01-Ф5	2 Characteristics of the main systems of electricity production and consumption	8
ПР01.01-Ф5	3 Features of the power system of Ukraine	8
ПР01.01-Ф5	4 Characteristics of electricity consumers and their operation modes	
ПР01.01-Ф5, ПР19.01-Ф5	5 Methods of calculating electrical loads of consumers	8
ПР01.01-Ф5, ПР19.01-Ф5	6 Characteristics of electrical network substations and their basic equipment	8
ПР01.01-Ф5, ПР19.01-Ф5	7 Choice of power transformers and units for reactive power compensation	8
ПР01.01-Ф5, ПР19.01-Ф5	8 Power lines and features of their design and selection	8
ПР19.01-Ф5	9 Energy saving in industry and the municipal sector	6
ПР13.01-Ф5	10 Scenarios for the development of electricity generation systems in the IPS of Ukraine	6
ПР13.01-Ф5	11 Energy Strategy of Ukraine until 2035	6
	PRACTICAL CLASSES	**50**
ПР01.01-Ф5, ПР19.01-Ф5	1 Calculation of electrical loads	20
ПР01.01-Ф5	2. Calculation and selection of power transformers, power lines	20
ПР19.01-Ф5	3. Analysis of the peculiarities of the operation modes of the main electrical equipment of substations and networks from the standpoint of energy- and resource-saving	10
	LABORATORY CLASSES	**50**
ПР19.01-Ф5, ПР13.01-Ф5,	1. Determining the indicators of electrical load schedules of generation and consumption systems	10

Code of DLO	Types and topics of training sessions	Volume of components, *hours*
ПР04.01-Ф5		
ПР19.01-Ф5, ПР13.01-Ф5, ПР04.01-Ф5	2. Determining the impact of non-uniformity of the schedule of electrical loads on the efficiency of electricity production	10
ПР01.01-Ф5, ПР19.01-Ф5	3. Calculation of the consumers' electrical loads	15
ПР01.01-Ф5, ПР19.01-Ф5	4. Reactive power compensation in electrical networks	15
	TOTAL	**180**

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 DUT is carried out on a rating (100-point) and institutional scales. The latter is necessary (in case of the official absence of a national scale) for the conversion (translation) of grades of mobile students.

Scales for assessing the academic achievements of students of DUT

Rating	Institutional
90…100	Excellent
74…89	Good
60…73	Satisfactory
0…59	Fail

Credits of the discipline are credited if the student received a final grade of at least 60 points. The lower grade is considered to be an academic debt that is subject to elimination in accordance with the Regulations on the organization of the educational process of DUT.

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 NQF to the 6th qualification level during the demonstration of learning outcomes regulated by the work program. The student must perform tasks

aimed exclusively at demonstrating disciplinary learning outcomes at control activities (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 evaluation procedures

<table>
<tr><th colspan="3">CURRENT CONTROL</th><th colspan="2">FINAL CONTROL</th></tr>
<tr><th>Educational class</th><th>diagnostic tools</th><th>procedures</th><th>засоби діагностики</th><th>procedures</th></tr>
<tr><td>lectures</td><td>control tasks for each topic</td><td>performing the task during lectures</td><td rowspan="6">complex control work (CCW)</td><td rowspan="6">determination of the average result of current controls

performing of CCW during the exam at the request of the student</td></tr>
<tr><td rowspan="2">practical</td><td>control tasks for each topic</td><td>performing the task during practical classes</td></tr>
<tr><td>or an individual task</td><td>performing the task during individual work</td></tr>
<tr><td rowspan="2">Laboratory lessons</td><td>Control task for each the topic</td><td>completing the assignment during the lesson</td></tr>
<tr><td>or individual task</td><td>completing the assignment during the self-study</td></tr>
</table>

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

If the content of a certain type of classes is subject to several descriptors, the integral value of the assessment can be determined taking into account the weights set by the teacher.

If there is a level of results of current controls in all types of classes at least 60 points, the final control is carried out without the participation of the student by determining the weighted average of current grades.

Regardless of the results of the current control, each student during the exam has the right to perform the CCW, which contains tasks that cover key disciplinary learning outcomes.

The number of specified tasks of the CCW should correspond to the allotted time for execution. The number of CCW options should provide individualization of the task.

The value of the assessment for the implementation of the CCW is determined by the average assessment of the components (specified tasks) and is final. The integral value of the assessment of the implementation of the CCW can be determined taking into account the weights set by the department for each descriptor of the NQF.

6.3 Criteria

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

To assess the performance of control tasks during the current control of lectures and practical classes the coefficient of mastery is used as a criterion, which automatically adapts the assessment indicator to the rating scale:

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

where a is a number of correct answers or significant operations performed in accordance with the decision standard; m is the total number of questions or significant operations of the standard.

Individual tasks and complex tests are assessed expertly using criteria that characterize the ratio of requirements to the level of competencies and indicators of assessment on a rating scale. The content of the criteria is based on the competency characteristics defined by the NQF for the master's level of higher education (below).

General criteria for achieving learning outcomes for the 6th qualification level for NQF (bachelor)

Integral competence is the ability to solve complex problems and problems in a certain field of professional activity or in the learning process, which involves research and / or innovation and is characterized by uncertainty of conditions and requirements.

NQF descriptors	Requirements for knowledge, skills, communication, autonomy and responsibility	Indicator of evaluation
	Knowledge	
♦ conceptual knowledge acquired in the process of learning and professional activity, including certain knowledge of modern achievements; ♦ critical understanding of basic theories,	The answer is excellent - correct, reasonable, meaningful. Characterizes the presence of: - conceptual knowledge; - high level of mastery of the content of the issue; - critical understanding of basic theories, principles, methods and concepts in teaching and professional activities	95-100
	The answer contains minor errors or omissions	90-94
	The answer is correct, but has some inaccuracies	85-89

NQF descriptors	Requirements for knowledge, skills, communication, autonomy and responsibility	Indicator of evaluation
principles, methods and concepts in teaching and professional activities	The answer is correct, but has some inaccuracies and is insufficiently substantiated	80-84
	The answer is correct, but has some inaccuracies, insufficiently substantiated and meaningful	75-79
	The answer is fragmentary	70-74
	The answer demonstrates the student's vague ideas about the object of study	65-69
	The level of knowledge is minimally satisfactory	60-64
	The level of knowledge is unsatisfactory	<60
Skills		
▪ solving complex problems and problems that require updating and integration of knowledge, often in conditions of incomplete / insufficient information and conflicting requirements; conducting research and / or innovation activities	The answer characterizes the ability to: - identify problems; - formulate hypotheses; - solve problems; - update knowledge; - integrate knowledge; - to carry out innovative activity; - to carry out scientific activity	95-100
	The answer characterizes the ability to apply knowledge in practice with minor errors	90-94
	The answer characterizes the ability to apply knowledge in practice, but has some inaccuracies in the implementation of one requirement	85-89
	The answer characterizes the ability to apply knowledge in practice, but has some inaccuracies in the implementation of the two requirements	80-84
	The answer characterizes the ability to apply knowledge in practice, but has some inaccuracies in the implementation of the three requirements	75-79
	The answer characterizes the ability to apply knowledge in practice, but has some inaccuracies in the implementation of the four requirements	70-74
	The answer characterizes the ability to apply knowledge in practice when performing tasks on the model	65-69
	The answer characterizes the application of knowledge in performing tasks on the model, but with inaccuracies	60-64
	The level of skills is unsatisfactory	<60
Communication		
♦ clear and unambiguous presenting of own conclusions, as well as knowledge and explanations that substantiate them, to specialists and non-specialists, in	Clarity of the answer (report). Language: - correct; - clean; - clear; - accurate; - logical; - expressive; - concise. Communication strategy:	95-100

NQF descriptors	Requirements for knowledge, skills, communication, autonomy and responsibility	Indicator of evaluation
particular to students; ♦ use of foreign languages in professional activities	- 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; - use of foreign languages in professional activities	
	Sufficient clarity of the answer (report) with minor errors; Appropriate communication strategy with minor flaws	90-94
	Good clarity of the answer (report) and appropriate communication strategy (three requirements in total are not realized)	85-89
	Good clarity of response (report) and appropriate communication strategy (four requirements not implemented in total)	80-84
	Good comprehensibility of the answer (report) and appropriate communication strategy (five requirements in total are not fulfilled)	75-79
	Satisfactory clarity of response (report) and appropriate communication strategy (a total of seven requirements not implemented)	70-74
	Satisfactory comprehensibility of the answer (report) and communication strategy with errors (nine requirements are not implemented in total)	65-69
	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
Autonomy and responsibility		
♦ responsibility for the development of professional knowledge and practices, assessment of the strategic development of the team; ♦ ability to further study, which is largely autonomous and independent	Excellent competence: - use of principles and methods of organizing team activities; - effective distribution of powers in the team structure; - maintaining a balanced relationship with team members (responsibility for the relationship); - stress resistance; - self-regulation; - work activity in extreme situations; - the level of personal attitude to the case; - mastery of all types of educational activities; - degree of possession of fundamental knowledge; - the appropriate level of formation of general educational skills and abilities	95-100
	Confident mastery of the competencies of autonomy and	90-94

NQF descriptors	Requirements for knowledge, skills, communication, autonomy and responsibility	Indicator of evaluation
	responsibility with minor flaws	
	Good mastery of autonomy and responsibility competencies (two requirements not met)	85-89
	Good mastery of autonomy and responsibility competencies (three requirements not met)	80-84
	Good mastery of autonomy and responsibility competencies (four requirements not met)	75-79
	Satisfactory mastery of autonomy and responsibility competencies (five requirements not met)	70-74
	Satisfactory mastery of autonomy and responsibility competencies (six requirements not met)	65-69
	Satisfactory mastery of autonomy and responsibility competencies (fragmentary level)	60-64
	The level of autonomy and responsibility is unsatisfactory	<60

7. TOOLS, EQUIPMENT AND SOFTWARE

Technical training tools. Moodle remote platform

8. Recommended sources of information

1. Тулуб С.Б., Разумний Ю.Т., Рухлов А.В. Проблеми сучасної енергетики. Навч. посібник в 2 ч. – Д.: Національний гірничий університет, 2007. Ч. 1. – 192 с. / 1. Tulub SB, Razumny UT, Rukhlov AV Problems of modern energy. Teaching. manual in 2 hours - D .: National Mining University, 2007. Part 1. - 192 p.
2. Маліновський А.А., Хохулін Б.К. Основи електроенергетики та електропостачання: Підручник. – Львів: Видавництво Національного університету “Львівська політехніка”, 2007.– 380 с. / Malinovsky AA, Khokhulin BK Fundamentals of power engineering and power supply: Textbook. - Lviv: Lviv Polytechnic National University Publishing House, 2007.– 380 p.
3. Проектування електрообладнання об’єктів цивільного призначення. ДБН В. 2.5-23-2010. – К.: Держ. ком. України з буд-ва. та архіт., 2004. – 129 с. / Design of electrical equipment for civil purposes. DBN V. 2.5-23-2010. - K .: Держ. com. Of Ukraine from the building. and Architect., 2004. - 129 p.
4. Бондарчук А.С. Внутрішньоквартальне електропостачання. Курсове проектування. Навчальний посібник / А.С. Бондарчук, В.Г. Рудницький. – Суми: Університетська книга, 2012. – 371 с. / Bondarchuk AS Intra-quarter power supply. Course design. Textbook / A.S. Bondarchuk, VG Rudnytsky. - Sumy: University Book, 2012. - 371 p.

5. Ціни та тарифи [Електронний ресурс] www.nerc.gov.ua/ / Prices and tariffs [Electronic resource] www.nerc.gov.ua/
6. Разумний, Ю.Т. Енергозбереження: навч. посіб. / Ю.Т. Разумний, В.Т. Заїка, Ю.В. Степаненко. – Дніпропетровськ: НГУ, 2005. – 166 с. / Reasonable, Yu.T. Energy saving: textbook. way. / Ю.Т. Razumny, VT Zaika, Yu.V. Stepanenko. - Dnepropetrovsk: NMU, 2005. - 166 p.
7. Вирівнювання графіка електричного навантаження енергосистеми. Режим доступу: http://www.energetika.by/arch/~page__m21=10~news __m21=169. / Alignment of the schedule of electric load of the power system. Access mode: http://www.energetika.by/arch/~page__m21=10~news __m21 = 169.
8. ЕнергетикаУкраїни 2018. Інфоргафічний довідник. Видання 2-ге. – 2018. – 44 с. Режим доступу: https://businessviews.com.ua/ru/the-infographics-report-energy-of-ukraine-2018/ / Energy of Ukraine 2018. Infographic guide. 2nd edition. - 2018. - 44 p. Access mode: https://businessviews.com.ua/ru/the-infographics-report-energy-of-ukraine-2018/
9. Стан і перспективи розвитку технологій «інтелектуальних» електромереж, управління попитом та систем режимного управління в умовах розвитку поновлюваних джерел енергії у зарубіжній енергетичній сфері. Київ – 03/2018. Режим доступу: **https://ua.energy/wp-content/uploads/2018/04/1.-Stan-rozvytku-smart-grid.pdf /** Status and prospects of development of technologies of "intelligent" power grids, demand management and control systems in the conditions of development of renewable energy sources in the foreign energy sphere. Kyiv - 03/2018. Access mode: **https://ua.energy/wp-content/uploads/2018/04/1.-Stan-rozvytku-smart-grid.pdf /** New energy strategy of Ukraine until 2035: "SECURITY, ENERGY EFFICIENCY, COMPETITIVENESS". Access mode: http://mpe.kmu.gov.ua/minugol/doccatalog/document?id=245213112
10. Нова енергетична стратегія України до 2035 року: «БЕЗПЕКА, ЕНЕРГОЕФЕКТИВНІСТЬ, КОНКУРЕНТОСПРОМОЖНІСТЬ». Режим доступу: http://mpe.kmu.gov.ua/minugol/doccatalog/document?id=245213112
11. Звіти з оцінки відповідності (достатності) генеруючих потужностей НЕК «Укренерго». Режим доступу: https://ua.energy/peredacha-i-dyspetcheryzatsiya/zvit-z-otsinky-vidpovidnosti-dostatnosti-generuyuchyh-potuzhnostej/#1596701774919-04e9ab60-f849 / Reports on conformity assessment (adequacy) of generating capacities of NEC Ukrenergo. Access mode: https://ua.energy/peredacha-i-dyspetcheryzatsiya/zvit-z-otsinky-vidpovidnosti-dostatnosti-generuyuchyh-potuzhnostej/#1596701774919-04e9ab60-f849

Educational Edition

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«Basics of electricity production, distribution and consumption» of 141 Specialty «Electric Power Engineering, electrical engineering and electromechanics»

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