

MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
Federal State Autonomous Educational Institution for Higher Education
«North-Caucasus Federal University»

APPROVED BY

Dean of FPE of NCFU

Candidate of Technical Sciences,

Associate Professor A.E. Verisokin

ASSESSMENT TOOLS FOR THE DISCIPLINE (MODULE)
« Special Lecture on Electrical Engineering»

Field of study	<u>13.04.02 Electric Power Engineering and Electrical Engineering</u>
Specialization (Profile)	<u>Training Program of Electrical Engineering</u>
Year of commencement of studies	<u>2026</u>
Mode of study	<u>full-time</u>
Implemented in semester(s)	<u>1</u>

Foreword

1. Purpose: This assessment tools (AT) document is intended to assess the level of competency formation during ongoing progress control and intermediate assessment of students in the discipline " Special Lecture on Electrical Engineering".

2. The AT is an appendix to the syllabus of the discipline "Special Lecture on Electrical Engineering".

3. Developer: Candidate of Technical Sciences,
Associate Professor of the Department of Automated Electric Power Systems and Power Supply, D.A. Kostyukov

4. The AT has undergone expert review.

Members of the expert group:

Chairperson: Yu. G. Kononov, Doctor of Technical Sciences, Professor, Head of the Department of Automated Electric Power Systems and Power Supply.

Committee members:

D.A. Kostyukov, Candidate of Technical Sciences, Associate Professor, Department of Automated Electric Power Systems and Power Supply.

A.V. Petrov, Candidate of Technical Sciences, Associate Professor, Department of Automated Electric Power Systems and Power Supply.

Representative of the employer organization:

S.A. Filippov, Candidate of Technical Sciences, Head of the Leninsky District Department of the Stavropol Interdistrict Branch of the PJSC «Stavropolenergosbyt».

Expert opinion: The AT is recommended for assessing the level of competency formation during ongoing progress control and intermediate assessment of students in the discipline " Theory of Electrical Networks ".

5. The validity period of the AT is determined by the period of implementation of the educational program.

1. Description of indicators and criteria for assessment at various stages of their formation, description of grading scales

Competency(ies), indicator(s)	Levels of competency formation			
	Minimum level not achieved (Unsatisfactory) – 2 points	Minimum level (Satisfactory) – 3 points	Medium level (Good) – 4 points	High level (Excellent) – 5 points
PC-1. Capable of participating in research and development activities in the field of electrical power engineering				
Learning outcomes for the discipline (module): Indicator: ИД-4. Prepares applications for industrial property objects.	Partially possesses the skills of understanding of fundamentals of overhead power line design and selects equipment parameters, taking into account technical constraints	Has a general understanding of fundamentals of overhead power line design and selects equipment parameters, taking into account technical constraints	Possesses understands the fundamentals of overhead power line design and selects equipment parameters, taking into account technical constraints.	Fully understands the fundamentals of overhead power line design and selects equipment parameters, taking into account technical constraints.

ASSESSMENT TOOLS FOR CHECKING THE LEVEL OF COMPETENCY FORMATION

Task No.	Correct Answer	Question Content	Competency
1.	1	The voltage $v(t) = 141.4 \cos(\omega t)$ is applied to a load consisting of a $10\text{-}\Omega$ resistor in parallel with an inductive reactance $X_L = \omega L = 3.77 \text{ W}$. Calculate the instantaneous power absorbed by the resistor. 1) $1000[1 + \cos(2\omega t)]$ 2) $1414[1 + \cos(2\omega t)]$ 3) $1000[1 - \cos(2\omega t)]$ 4) $1414[1 + \cos(\omega t)]$	PC-1
2.	1	The voltage $v(t) = 141.4 \cos(\omega t)$ is applied to a load consisting of a $10\text{-}\Omega$ resistor in parallel with an inductive reactance $X_L = \omega L = 3.77 \text{ W}$. Calculate the instantaneous power absorbed by the inductor. 1) $2653\sin(2\omega t)$ 2) $2653\cos(2\omega t)$ 3) $2653\sin(\omega t)$ 4) $2653\cos(\omega t)$	PC-1
3.	1	The voltage $v(t) = 141.4 \cos(\omega t)$ is applied to a load consisting of a $10\text{-}\Omega$ resistor in parallel with an inductive reactance $X_L = \omega L = 3.77 \text{ W}$. Calculate the real power absorbed by the load. 1) 1000W 2) 1414W 3) 500W 4) 707W	PC-1

4.	1	The voltage $v(t) = 141.4 \cos(\omega t)$ is applied to a load consisting of a $10\text{-}\Omega$ resistor in parallel with an inductive reactance $X_L = \omega L = 3.77 \text{ }\Omega$. Calculate the reactive power absorbed by the load. 1) 2653var 2) 2653W 3) 1414W 4) 1414var	PC-1
5.	1	The voltage $v(t) = 141.4 \cos(\omega t)$ is applied to a load consisting of a $10\text{-}\Omega$ resistor in parallel with an inductive reactance $X_L = \omega L = 3.77 \text{ }\Omega$. Calculate the power factor. 1) 0.3528 lag 2) 0.3528 lead 3) 0.6456 lag 4) 0.6456 lead	PC-1
6.	1	A single-phase voltage source with $V = 100\angle 130^\circ$ volts delivers a current $I = 10\angle 10^\circ$ A, which leaves the positive terminal of the source. Calculate the source real power. 1) -500 W 2) 500 W 3) 866 W 4) -500 var	PC-1
7.	1	A single-phase voltage source with $V = 100\angle 130^\circ$ volts delivers a current $I = 10\angle 10^\circ$ A, which leaves the positive terminal of the source. Calculate the source reactive power. 1) 866var 2) -866 var 3) 866W 4) 500 var	PC-1
		A single-phase source delivers 100 kW to a load operating at a power factor of 0.8 lagging. Calculate the angle	

8.	1	of power triangle. 1) 36.87° 2) -36.87° 3) 42.3° 4) -42.3°	PC-1
9.	1	A single-phase source delivers 100 kW to a load operating at a power factor of 0.8 lagging. Calculate the active power to be delivered by a capacitor connected in parallel with the load in order to raise the source power factor to 0.95 lagging. Assume that the source voltage is constant, and neglect the line impedance between the source and load. 1) 0W 2) 100W 3) 36.4 var 4) 100var	PC-1
10.	1	A single-phase source delivers 100 kW to a load operating at a power factor of 0.8 lagging. Calculate the reactive power to be delivered by a capacitor connected in parallel with the load in order to raise the source power factor to 0.95 lagging. Assume that the source voltage is constant, and neglect the line impedance between the source and load. 1) 42.13 var 2) 42.13 W 3) 32.87 var 4) 105.3 var	PC-1
11.		A single-phase source delivers 100 kW to a load operating at a power factor of 0.8 lagging. Draw the power triangle for the source.	PC-1
12.		A single-phase source delivers 100 kW to a load operating at a power factor of 0.8 lagging. Draw the power triangle for the load.	PC-1
13.		A balanced, positive-sequence, Y-connected voltage source with $E_{ab} = 480 \angle 0^\circ$ volts is applied to a balanced- Δ load with $Z_{\Delta} = 30 \angle 40^\circ \Omega$. The line impedance between the source and load is $Z_L = 1 \angle 85^\circ \Omega$ for each phase. Calculate the line currents.	PC-1
14.		A balanced, positive-sequence, Y-connected voltage source with $E_{ab} = 480 \angle 0^\circ$ volts is applied to a balanced- Δ load with $Z_{\Delta} = 30 \angle 40^\circ \Omega$. The line impedance between the source and load is $Z_L = 1 \angle 85^\circ \Omega$ for each phase. Calculate the Δ -load currents.	PC-1

15.		A balanced, positive-sequence, Y-connected voltage source with $E_{ab} = 480 \angle 0^\circ$ volts is applied to a balanced- Δ load with $Z_{\Delta} = 30 \angle 40^\circ \Omega$. The line impedance between the source and load is $Z_L = 1 \angle 85^\circ \Omega$ for each phase. the voltages at the load terminals.	PC-1
16.		Two balanced three-phase motors in parallel, an induction motor drawing 400 kW at 0.8 power factor lagging and a synchronous motor drawing 150 kVA at 0.9 power factor leading, are supplied by a balanced, three-phase 4160-volt source. Cable impedances between the source and load are neglected, Draw the power triangle for each motor and for the combined-motor load.	PC-1
17.		Two balanced three-phase motors in parallel, an induction motor drawing 400 kW at 0.8 power factor lagging and a synchronous motor drawing 150 kVA at 0.9 power factor leading, are supplied by a balanced, three-phase 4160-volt source. Cable impedances between the source and load are neglected, Determine the power factor of the combined-motor load.	PC-1
18.		Two balanced three-phase motors in parallel, an induction motor drawing 400 kW at 0.8 power factor lagging and a synchronous motor drawing 150 kVA at 0.9 power factor leading, are supplied by a balanced, three-phase 4160-volt source. Cable impedances between the source and load are neglected, Determine the magnitude of the line current delivered by the source	PC-1
19.		Two balanced three-phase motors in parallel, an induction motor drawing 400 kW at 0.8 power factor lagging and a synchronous motor drawing 150 kVA at 0.9 power factor leading, are supplied by a balanced, three-phase 4160-volt source. Cable impedances between the source and load are neglectedA delta-connected capacitor bank is now installed in parallel with the combined-motor load. What value of capacitive reactance is required in each leg of the capacitor bank to make the source power factor unity?	PC-1
20.		Two balanced three-phase motors in parallel, an induction motor drawing 400 kW at 0.8 power factor lagging and a synchronous motor drawing 150 kVA at 0.9 power factor leading, are supplied by a balanced, three-phase 4160-volt source. Cable impedances between the source and load are neglected, Determine the magnitude of the line current delivered by the source with the capacitor bank installed.	PC-1
21.		Three loads are connected in parallel across a single-phase source voltage of 240 V (RMS). Load 1 absorbs 12 kW and 6.667 kVAR; Load 2 absorbs 4 kVA at 0.96PF leading; Load 3 absorbs 15 kW at unity power factor. Calculate the equivalent impedance, Z, for the three parallel loads, for two cases: Series combination of R and X.	PC-1
22.		Three loads are connected in parallel across a single-phase source voltage of 240 V (RMS). Load 1 absorbs 12 kW and 6.667 kVAR; Load 2 absorbs 4 kVA at 0.96PF leading; Load 3 absorbs 15 kW at unity power factor. Calculate the equivalent impedance, Z, for the three parallel loads, for two cases: Parallel combination of R and X.	PC-1
23.		In per-unit equivalent circuits of practical three-phase transformers, under balanced three-phase operation, in which of the following connections would a phase-shifting transformer come up?	PC-1
		A single-phase 100-kVA, 2400/240-volt, 60-Hz distribution transformer is used as a step-down transformer. The load, which	

24.		is connected to the 240-volt secondary winding, absorbs 80 kVA at 0.8 power factor lagging and is at 230 volts. Assuming an ideal transformer, calculate the following: primary voltage.	PC-1
25.		A single-phase 100-kVA, 2400/240-volt, 60-Hz distribution transformer is used as a step-down transformer. The load, which is connected to the 240-volt secondary winding, absorbs 80 kVA at 0.8 power factor lagging and is at 230 volts. Assuming an ideal transformer, calculate the following: load impedance.	PC-1
26.		A single-phase 100-kVA, 2400/240-volt, 60-Hz distribution transformer is used as a step-down transformer. The load, which is connected to the 240-volt secondary winding, absorbs 80 kVA at 0.8 power factor lagging and is at 230 volts. Assuming an ideal transformer, calculate the following: load impedance referred to the primary.	PC-1
27.		A single-phase 100-kVA, 2400/240-volt, 60-Hz distribution transformer is used as a step-down transformer. The load, which is connected to the 240-volt secondary winding, absorbs 80 kVA at 0.8 power factor lagging and is at 230 volts. Assuming an ideal transformer, calculate the following: the real and reactive power supplied to the primary winding.	PC-1
28.		A single-phase step-down transformer is rated 15 MVA, 66 kV/11.5 kV. With the 11.5 kV winding short-circuited, rated current flows when the voltage applied to the primary is 5.5 kV. The power input is read as 100 kW. Determine R_{eq1} in ohms referred to the high-voltage winding.	PC-1
29.		A single-phase step-down transformer is rated 15 MVA, 66 kV/11.5 kV. With the 11.5 kV winding short-circuited, rated current flows when the voltage applied to the primary is 5.5 kV. The power input is read as 100 kW. Determine X_{eq1} in ohms referred to the high-voltage winding.	PC-1
30.		If the per-phase line loss in a 60-km-long transmission line is not to exceed 60 kW while it is delivering 100 A per phase, compute the required conductor diameter, if the resistivity of the conductor material is $1.72 \cdot 10^{-8} \Omega m$.	PC-1

2. Description of the grading scale

Within the framework of the rating system, student performance in each discipline is assessed during ongoing progress control and intermediate assessment. The rating system for assessing student knowledge is based on the use of a set of control measures (checkpoints) for testing the material covered, optimally located throughout the entire time interval of studying the discipline. The principles of the rating system for assessing student knowledge are based on the provisions described in the "Regulations on the organization of the educational process based on the rating system for assessing student knowledge" at North Caucasus Federal University.

The rating assessment system is not provided for students studying in master's degree programs, or for students studying in bachelor's degree programs by correspondence or part-time (evening) forms of study.

3. Criteria for assessing competencies

The grade "Excellent" is awarded to a student who has deeply and firmly mastered the program material, presents it exhaustively, consistently, clearly, and logically coherently, is able to closely link theory with practice, handles tasks, questions, and other types of knowledge application with ease, and does not struggle to answer when assignments are modified.

The grade "Good" is awarded to a student who has a solid command of the material, presents it competently and substantively without making significant inaccuracies in answering questions, correctly applies theoretical principles to practical questions and tasks, and possesses the necessary skills and techniques for their execution.

The grade "Satisfactory" is awarded to a student who has knowledge of only the basic material but has not mastered its details, makes inaccuracies, insufficiently correct formulations, and violates logical sequence in presenting the program material.

The grade "Unsatisfactory" is awarded to a student who does not know a significant part of the program material and makes substantial errors.