

Ministry of Education and Science of the Republic of Kazakhstan
Non-commercial Joint Stock Company "Holding "Kasipkor"

EDUCATIONAL PROGRAM

Specialty: 1518000 “Electrification and automation of agriculture”

Qualifications: Electrical fitter
Electrician
Electrical technician
Junior electrical engineer

Astana – 2016

DEVELOPED

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EXPERTS

- Bildungsinstitut PSCHERER gGmbH (Германия)
- RPA “Association of farmers of Kazakhstan”
- Academic methodical association of “Electrification and automation of agriculture” on the basis of Talgar college of agribusiness and management

CONSIDERED, APPROVED AND RECOMMENDED

At a meeting of the Republican educational-methodical Council for Technical and Vocational Education of the MES RK, protocol No_4_ dated "_21_"_12__ 2016 year

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1. Explanatory note to the educational program

This educational program has been developed on the basis of modular and competency-based approach taking into account relevant international requirements for mid-level professionals and skilled workers, with the participation of foreign partner – Dreberis (Germany).

Main provisions of the following was used when designing the educational program:

a) international conceptual documents on classification of educational programs and the corresponding qualifications:

- 2001 Recommendation concerning Technical and vocational education and training in the twenty-first century.
- UNESCO's 2011 International Standard Classification of Education (ISCED)
- ISCED Fields of Education and Training 2013
- European Qualifications Framework (EQF)

b) Laws and national programmes of the Republic of Kazakhstan and normative documents in the field of education:

- The Law of the Republic of Kazakhstan On Education, 2007;
- State Programme for the education development in the Republic of Kazakhstan for 2011-2020;
- State Programme on industrial-innovative development of the Republic of Kazakhstan for 2015-2019;
- National Classifier of professions and specialties in technical and vocational, post-secondary education of the Republic Kazakhstan the NC RK 05-2008, appr.;
- National Qualifications Framework of the Republic of Kazakhstan (joint Order from the Minister of Labour and Social Protection of Population of the Republic of Kazakhstan of September 24, 2012 no. 373-o-m and from the Minister of Education and Science of the Republic of Kazakhstan of September 28, 2012 no. 444);
- RK Mandatory State Standard of technical and vocational education approved by Governmental Decree of the Republic of Kazakhstan of August 23, 2012, no. 1080.
- Model rules for the conduct of ongoing monitoring of school performance, intermediate and final assessment of students, approved by Order from the Minister of Education and Science of the Republic of Kazakhstan of March 18, 2008 no. 125.
- Methodologies in the development of model curricula and educational curricula, integrated educational programmes on specialties in technical and vocational education, approved by Order from the Minister of Education and Science of the Republic of Kazakhstan of 09.05. 2016 no. 446
- The Development Strategy of Holding Kasipkor NC JSC for 2012-2021 (Decree of the Government of the Republic of Kazakhstan of December 31, 2011, no. 1751).

This educational program on the speciality **Electrification and Automation of Agriculture**, taking into account the integrations of the content of educational programmes by qualifications levels, provides for:

- 1) awarding established level of working qualification – Electrical fitter (NQF

Level 3) – Electrician (NQF Level 3);

2) awarding qualification of a mid-level professional – Electrical technician (NQF Level 4);

3) awarding qualification of applied bachelor level – Junior electrical engineer » (NQF Level 5).

Types and levels of qualifications on specialty "**Electrification and Automation of Agriculture**" are defined in accordance with the types of professional activities specified in the functional map according to Sectoral Qualifications Frame.

Possible qualification levels according to NQF

- Electrical fitter (NQF Level 3)

- Electrician (NQF Level 3)

Standard term of training: on the basis of the basic secondary education according to the GOSO TiPO (Mandatory State Standard of technical and vocational education) not longer than 2 years and 10 months;

on the basis of general secondary education - not longer than 1 year and 10 months.

to achieve qualification of mid-level professionals

- Electrical technician (NQF Level 4) duration of training is +10 months.

with the study of program of applied undergraduate with award of qualification of

- Junior electrical engineer (NQF Level 5) term of training is extended for another +10 months.

Integration of educational programs on the given speciality through unified base of general professional and vocational training modules of the above qualifications allow to reduce the overall time-frame for learning.

1. Analysis of the specialty

Organization and execution of works to ensure high-quality work of the electric facilities of agricultural consumers (electrical installations, electrical energy sinks, electrical networks) and automated systems of agricultural machinery, availability of qualified personnel on a speciality "**Electrification and Automation of Agriculture**", who possess special competence, relevant to basic types of professional tasks:

- installing electric equipment and automated control systems.
- installing and operating lighting and electric heating installations.
- maintaining the operation modes and pre-set parameters of electric and automated control systems.
- ensuring uninterrupted power supply of agricultural enterprises.
- installing overhead power lines and transformer substations.
- ensuring electrical safety.
- performing maintenance of electric equipment and automated systems of agricultural machinery.
- Diagnosing problems and carrying out repair and overhaul of electric equipment and automated systems of agricultural machinery.
- monitoring the condition and operation of electric equipment and automated systems of agricultural machinery.

- testing electric equipment of agricultural production.
- planning the main indicators in the field of serviceability of electric facilities and automated systems of agricultural machinery.
- planning execution of works by executors.
- organizing work of labour collective.
- overseeing and evaluating the results of execution of works.

Scope of professional activities

Organization and performance of works on maintenance of efficiency of electrical facilities of agricultural consumers (organization and performance of works on maintenance of electrical machinery, machinery, electrical installations, devices, and other engineering and process equipment of agricultural designation, receivers of electrical energy, electrical networks) and automated systems of agricultural machinery.

Objects of professional tasks:

- electrical installations and receivers of electrical energy;
- electric networks;
- automated systems for agricultural machinery;
- technological processes of installation; adjustment; operation; maintenance and diagnosing of electrical installations and receivers of electrical energy, electrical networks, automated systems of agricultural machinery;
- technological processes of transmission of electric energy;
- organization and management of the work of the specialized units of the agricultural organizations;
- primary labour collectives.

On the content of works performed, the specialty “Electrification and Automation of Agriculture” conjoins with other professions of working positions according to the Classifier of occupations GK RK 01-2005 as amended on 01.01.2006 and NQF PK, such as:

- 7241 Assembling fitters of electrical and electromechanical devices;
- 7233 Electrical fitter for repair and maintenance of electric equipment;
- 7233 Electrical fitter on operation of distribution networks;
- 7233 Shift electrician (fitter) and on equipment repair;
- 7241 Fitter on control and instrumentation (I&C);
- 7241 Electrical fitter on tests and measurements;
- 7241 Electrical fitter on repair of windings and isolation of electrical equipment;
- 7522 Electrical fitter on repair and installation of cable lines;
- 7522 Electrical fitter on repair and maintenance of electrical installations;
- 8281 Fitter on repair of agricultural machinery and equipment;
- 8283 Electrical fitter on repair of hardware, relay protection and automatics.

Mid-career professional with qualification Electrical technician (NQF Level 4)

should be ready to perform the following types of professional activities:

- *engineering and manufacturing* – operation and maintenance of working

modes and parameters of electric and automatic control systems of technological processes, machines and installations; maintenance, repair and overhaul of electrical equipment, energy agricultural installations, automation and communication facilities, instrumentation, microprocessor ware and computing tools; maintenance of technical documentation;

- *organizational and managerial* – organizing work of the team of performers, making reasonable managerial decisions; planning and organization of production activities; selecting optimal decisions when planning work in the conditions of non-standard situations; implementing quality control of works performed; participating in the evaluation of economic performance of production activities; ensuring occupational safety and environmental protection on production site.

Professional with the qualification of Junior electrical engineer

Knowledge: framework legislation and existing legal documentation on the development of agro-industrial complex at the present stage of economic reforms in Kazakhstan; fundamentals of organization of agricultural production and modern forms of governance; purpose, construction and operation of electrical equipment and automated systems used in crop and livestock production; methods of maintenance and repair of electrical equipment and automated systems; methods of their efficient use; rules of occupational safety, industrial sanitation, fire safety and environmental protection.

Skills: manage the workforce in the manufacturing site of the enterprises; organize work for efficient operation, maintenance and repair of electrical equipment and automated systems; prepare work schedules for energy service of the agricultural enterprise; oversee and monitor the status and operation of electrical equipment, technical means of automation, power plants and networks according to rules and regulations; analyze technical data, performance and results of the work of the electrified and automated equipment; develop and implement energy activities in agricultural production; supervise the observance of the rules of safety when carrying out works; develop activities in occupational safety and health to conduct instruction on health and safety and fire prevention activities during operation, maintenance and repair of electrical equipment and automated systems; take the necessary measures for the use of modern technical means in the work.

Qualification requirements by levels of qualifications in accordance with the Classifier of occupations, NQF, SQF, UWRB /professional standards.

Working skills – Electrical fitter

Knowledge of the regulations for the safe organization of the work of an electrical fitter and of occupational safety standards.

Perform installation and commissioning works and methods to ensure effective operation of systems of machines and equipment when testing technical means of mechanization of agriculture;

Build electric circuits and measure electrical quantities;

Simulation, using PC, of technical calculations, elements of electrification of production processes, maintenance and repair of machines and equipment.

Perform diagnostics of electrical machines, transformers and electrical materials used in them.

Use of technical means of automation and systems for control of parameters of agricultural technological processes.

Working knowledge of methodology of calculation of input electric load for agricultural consumers, the methodology of selection of cross-sections of internal wiring and overhead power lines.

Working knowledge of the methodology of fundamentals of the electrification of agricultural production, devices, principles of action, the main characteristics and methods of selection of electrical equipment and automation tools.

Perform installation, adjustment, and repair of elements of systems of centralized control and automated control of production processes in agriculture.

Use means of electrical safety and protection against the harmful effects of technical systems on humans.

Working skills – Electrician

Knowledge of the regulations for the safe organization of the work of an electrician and occupational safety standards.

Installation of electrical installations, electro-technological processes when choosing optimal solutions.

Use of electrical and structural materials for the construction, installation and operation of electrified and automated agricultural installations.

Knowledge of rules for quality control during installation of power supply, lighting, and electrical heating systems of agricultural objects.

Analysing the causes of malfunctions and failures of electric machines and apparatus, and generate recommendations of measures to improve operation reliability.

Perform maintenance and repair of wirings, lighting and irradiation facilities, devices and means of automation of electrical equipment used in agriculture.

Applying the basics of metrology, electrical measurements, standardisation, certification and quality control of products in electrification and automation of agriculture.

Assess the luminance level of production premises and territories, to review and make changes to existing systems

Be able to use methods of reliability tests of electrical equipment, to analyse causes of malfunctions and failures, to apply rational ways to restore components of electrical equipment.

Determine the feasibility of conducting repairs and lighting conditions in accordance with the standards of energy efficiency and the requirements of the guidance documents of the Republic of Kazakhstan.

Mid-career professional Electrical technician

Compliance with the requirements of the Law on Records Management of the Republic of Kazakhstan in the existing production document.

Working knowledge of the basics of the technological operations for quality control of works when cultivating crops, advanced technologies of production and preparation of forages and livestock.

Knowledge of the regulatory legislation of RK on labour, occupational safety rules and regulations on environmental protection.

Working knowledge of modern methods and tools of installation, adjustment and operation of power plants and their control systems.

Have skills of selection of electrical equipments and automation tools.

Maintenance and repair of facilities of rural electric networks, transformer substations, applying rules for their design and operation of irradiation facilities, devices and means of automation of electrical equipment used in agriculture;

Perform installation, maintenance, repair and adjustment of agricultural power, lighting and automated electrical installations and predefined parameters of electrified and automated agricultural technological processes, machines and installations.

Introduction of modern lighting devices and effective electrotechnics in agricultural production processes.

Applied Bachelor Junior electrical engineer

Working knowledge of the methodology of calculation and selection of energy saving installations, electrical technologies based on the use of alternative energy sources.

Compliance with the requirements of the electricity industry guidance documents of the Republic of Kazakhstan (Electrical installation code, Safety Rules for Operation of Customers' Electrical Installations, Regulation of fire safety, Operating and maintenance rules - REFM, PTF, FSR, OMR).

Knowledge of the agrarian law regulations and their introduction into the processes of agricultural production;

Application of methods of feasibility studies of use of electric equipment and electrical technologies in agricultural production.

Perform installation, adjustment, repair and maintenance of relay protection and automatic equipment, automation and protection against short circuits.

Working knowledge of the methods to calculate and select relay protection and automatic equipment, automation and protection against short circuits;

Working knowledge of methods of selection of reliability means in electrical networks and redundant power supplies for agricultural consumers;

Organization and application of new technologies for installation, commissioning, repair and maintenance of agricultural power, lighting and automation of electrical installations;

Working knowledge of basics of managing a production team, system of preventative maintenance, and rational exploitation of electrical equipment and automation tools for agricultural purposes

Training of specialists for qualitative implementation of the specified occupations is possible through the development of integrated educational programs on the specialty “Electrification and Automation of Agriculture” on the basis of modular competence-based approach.

2. Abbreviations and symbols

EP – educational program

NQF - National Qualifications Framework

SQF – Sectoral Qualifications Framework

BC – basic competence

PC - professional competence

CM – compulsory modules

GD – general subjects

GHaE – general humanities and economics

BGPM – basic general professional modules

SM - professional (specialty) modules

AM – additional modules (defined by the educational organization)

VT and PI – vocational training and professional internship

IA – interim assessment

ECA – end-of-course assessment

ELPSAQ – evaluation of the level of professional skills and award of qualification

3. Functional analysis of the speciality

1. Functional analysis of the specialty by types and levels of qualifications carried out for the formation of the general and professional competencies that enable to organize and implement maintainable electrical facilities of agricultural consumers (electrical installations, electrical energy receivers, electrical networks) and automated systems of agricultural machinery.

2. Professional activities:

of an electrical fitter on the speciality "Electrification and automation of agriculture" include:

- Operational and technical maintenance, repair of agricultural equipment, appliances, apparatus;
- installation of high-voltage equipment and measuring devices;
- laying of cables in trenches, canals, tunnels and inside the buildings;
- installation of earthing networks and grounding devices;
- Laying of lighting wirings.

of an electrician on the speciality "Electrification and automation of agriculture" include:

- Installation and repair of electrical equipment switchgears within agricultural enterprises;
- Installation and repair of equipment, machinery, vehicles and engines of electrified agricultural machinery;
- Installation and repair of electrical structures, lighting wirings and electrical networks in agricultural companies.

- All types of fitter's work for repair of electrical equipment.

Of an electrical technician on the speciality "Electrification and automation of agriculture" include:

- Electrification and automation of production processes in agriculture;
- Maintenance of electrical equipment in accordance with the requirements health and and occupational safety;
- Organisation of work to ensure smooth operation of electrical equipment, machinery, vehicles and engines;
- Decision-making in standard and extraordinary situations for timely elimination of arising causes for stopping the technological process.

of a Junior Engineer on the speciality "Electrification and automation of agriculture" include:

- Engineering and manufacturing and production and management work;
- Ensuring the efficiency of the organization of work for maintenance and repair of electrical equipment;
- Overseeing the work of electrotechnical personnel;
- Organization of work for the creation or reorganization of production sites (working areas).

Main labour functions:

- capable of mounting and adjusting the lighting, alarm devices, and controls and instrumentation;
- select the electric drives for basic agricultural machines and installations;
- calculate load and energy losses in electric networks, short-circuit currents, earthing devices;
- use electric machines and apparatus;
- use automation tools, carry out maintenance and repair of the model district and consumer transformer substations, protection schemes for high-voltage and low-voltage lines;
- oversee and monitor the status and operation of lighting and electrotechnical installations;
- carry out maintenance and repair of automated systems of technological processes, automatic control systems of electrical equipment and automation of agriculture;
- calculate, according to adopted methodology, key performance indicators of electrical facilities of agricultural consumers;
- select and implement activities to motivate and encourage staff;
- assess the quality of work performed.

3.1. Main labour functions for qualifications.

Electrical fitter:

- Operational and technical maintenance of switchgears and networks of agricultural electrical equipment, appliances and hardware;
- installation of high-voltage equipment, devices and instrumentation;
- laying of cables in trenches, canals, tunnels and inside the buildings;
- installation of earthing networks and grounding devices;

- Laying of lighting wirings.

Electrician:

- installation and repair of electrical equipment switchgears;
- installation and repair of electrical equipment, machinery, vehicles and engines;
- carry out fitter's work for maintenance of electrical equipment, mechanisms, machines and engines;
- installation and repair of electrical structures, lighting wirings and electrical equipment networks in agricultural companies.

Electrical technician:

- technical maintenance, preventive inspections and repairs of electrical equipment;
- preparation and production of blueprints of electrical diagrams of installation, assembly, wiring and the like;
- the control over correctness of operation of electrical equipment and systems, identifying the causes of malfunctions and failures in the operation of the equipment and eliminating them;
- instructing personnel that use electric equipment and devices on rules for their operation;

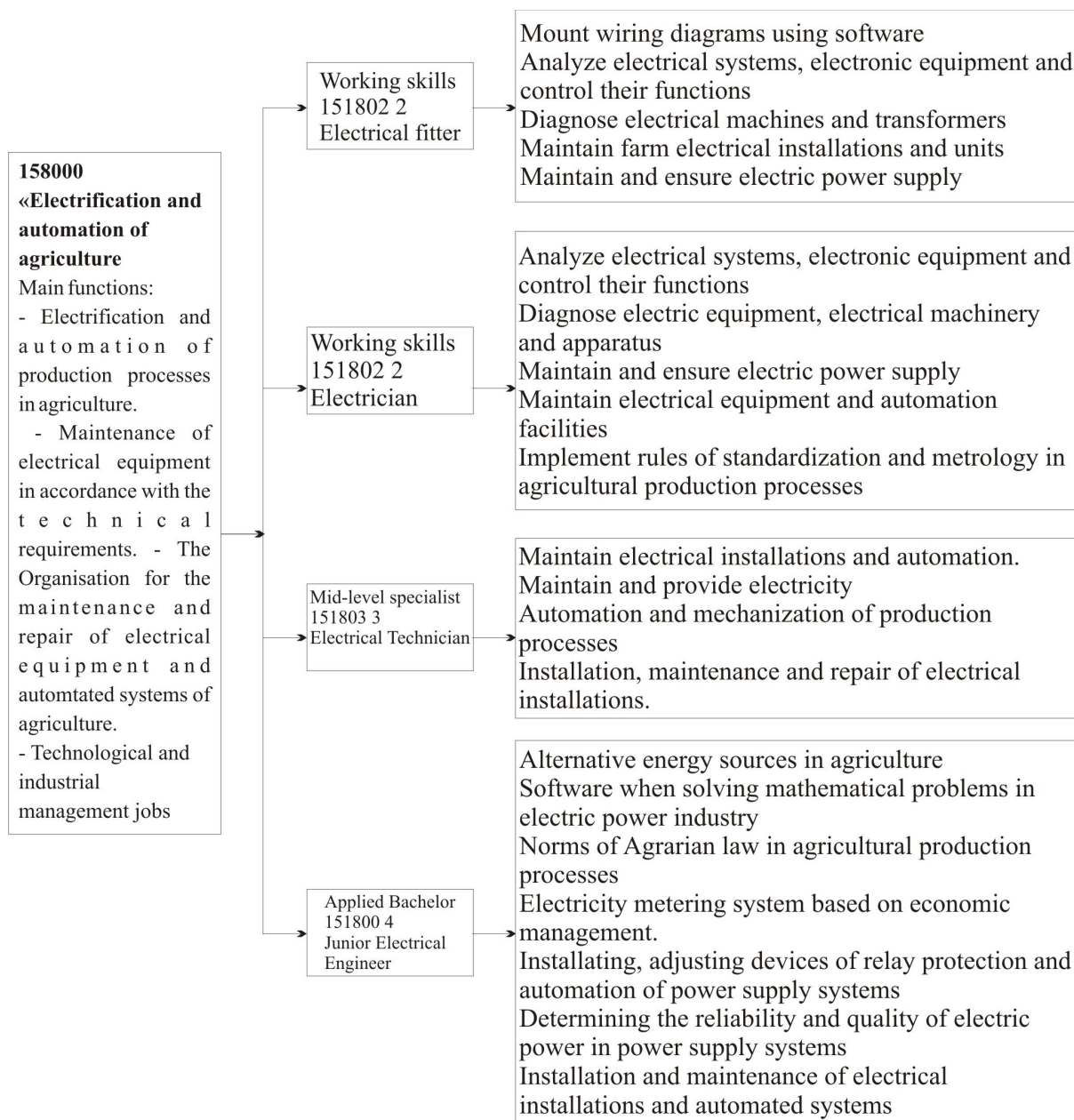
Junior electrical engineer:

- planning and organization of work in team, as well as in threatening situations;
- repairing and monitoring automatic systems and programming of control systems;
- performance evaluation;
- Organizing manufacturing processes and controlling work quality.

3.2 Functional map

Qualification

Qualification requirements



4.Requirements for Trainees' Levels of Training

The Section on "Requirements for Trainees' Levels of Training" specifies essential basic and professional competences by types of qualification levels (Table 3), in accordance with the NQF, SQF and professional standards.

Basic competences is a general description of the quality characteristics that are associated with specific activities. Description of basic competences may include requirements for the specialist's personality, which include: the level of development of thinking; communication skills; focus on achievements (result); ability to solve problems, etc.

Professional competences are categorized into the following types: general

competences; functional competences. Functional competences are defined separately on types and levels of qualifications, and general and cognitive competencies are defined in general by speciality. Functional competencies are formed in relation to the context of the labor process, i.e. are defined as broad and specific functions performed by a specialist in the field of professional activity.

Based on the functional competencies, a list of professional modules is defined for each qualification.

Table 3

Basic and professional competencies by levels

C o m p e t e n c e s	Requirements of industry/enterprise to trainees' level of training			
Basic competences	Code and name of the qualification (applied bachelor)	Code and name of the qualification (mid-level professional)	Code and name of the qualification (advanced level)	<p>151802 2 Electrical fitter, 151802 2 Electrician</p> <p>BC 1. Understanding the essence and social significance of their future profession, manifestation of sustained interest to it.</p> <p>BC 2. The ability to organize the workplace.</p> <p>BC 3. Working knowledge of professional vocabulary.</p> <p>BC 4. Work under the guidance of specialists of higher qualification.</p> <p>BC 5. Working knowledge of computerized methods for collecting, storing and processing of information;</p> <p>BC 6. Ability to work in a team, communicate effectively with colleagues, leadership, consumers</p> <p>BC 7. Application of the basic regulatory requirements according to the Electrical installation code, Safety Rules for Operation of Customers' Electrical Installations, Regulation of fire safety, Operating and maintenance rules (REFM, PTF, FSR, OMR).</p> <p>BC 8. Ability to work with electrical fitting and wiring tools.</p> <p>BC 9. Skills of reading electrical diagrams.</p> <p>BC10. Use of information and communication technologies to improve professional activities.</p>
				<p>151803 3 Electrical technician</p> <p>BC 11. The ability to organize their own activities, defining methods and ways to perform professional tasks, assessing their effectiveness and quality.</p> <p>BC 12. Search, analysis and evaluation of information required for raising and resolving professional objectives.</p> <p>BC 13. Manifestation of readiness for constant professional growth, acquisition of new knowledge.</p> <p>BC 14. Working knowledge of modern information technology.</p> <p>BC 15. Skills to build electrical circuits using computer programs.</p> <p>BC 16. Managing work of electrical personnel.</p> <p>BC 17. Monitoring the quality of work performed.</p> <p>BC 18. Decision-making in ordinary and extraordinary situations and assuming responsibility.</p>

		<p>151800 4 Junior Electrical Engineer</p> <p>BC 19. Analysing qualitative performance of energy systems and automatic control systems;</p> <p>BC 20. Working knowledge of sufficient training to acquire knowledge in the area of advanced technologies;</p> <p>BC 21. Generate ways to improve technical indicators of the quality of electric power control systems;</p> <p>BC 22. Evaluation of service quality of power plants and automatic control, introducing proposals on methods of correction.</p> <p>BC 23. Creation of conditions for staff development.</p> <p>BC 24. The experiment by the specified methods in the processing and analysis of the results.</p> <p>BC 25. Personnel planning.</p> <p>BC 26. The creation of organization or reorganization of production sites.</p> <p>BC 27. Solving problems, assess risks and make decisions in non-standard situations.</p> <p>BC 28. Goal setting, motivation of subordinates ' activities, organization and control of their work with the acceptance of responsibility for the results of their assignments.</p>		
P r o f e s s i o n a l c o m p e t e n c e	Code and name of the qualification (applied bachelor)	Code and name of the qualification (mid-level professional)	Code and name of the qualification (advanced level)	<p>151802 2 Electrician</p> <p>PC 2.1.1. Simulation using PC technical calculations connected with design elements of an electrifying production processes, maintenance and repair of machinery and equipment.</p> <p>PC 2.1.2. Diagnostics of electrical machines, transformers and electrical materials used in them.</p> <p>PC 2.1.3. The use of technical means of automation and control systems of technological processes in agricultural settings.</p> <p>PC 2.1.4. Working knowledge of electric load methodology for entering agricultural consumers, the methodology of choice sections inside wiring and overhead power lines.</p> <p>PC 2.1.5. Working knowledge of the methodology bases the electrification of agricultural production devices, principles of action, the main characteristics and methods of selection of electrical equipment and automation tools.</p> <p>PC 2.1.6. The production installation, adjustment, repair elements of the systems of centralized control and automated control of production processes in agriculture.</p> <p>PC 2.1.7. The use of measuring and regulation of technological processes.</p> <p>PC 2.18 Maintaining a healthy lifestyle.</p>
				<p>151802 2 Electrician</p> <p>PC 2.1.1. Perform locksmith parts processing with adjustment and fine-tuning;</p> <p>PC 2.1.2. Design and construction of electrical installations, electro-technological processes when choosing optimal solutions.</p> <p>PC 2.1.3. The use of electrical and structural materials for the construction, installation and maintenance of electric and automated agricultural installations.</p>

			<p>PC 2.1.4. Analysing the causes of malfunctions and failures of electric machines and apparatus, with the recommendation of measures to improve operation reliability.</p> <p>PC 2.1.5. Working knowledge of the core standards of the labour legislation of the Republic of Kazakhstan, rules and norms of protection.</p> <p>PC 2.1.6. Perform maintenance and repair wirings, lighting and irradiating installations, devices and means of automation of electrical equipment used in agriculture.</p> <p>PC 2.1.7. Working knowledge of the techniques of performing manufacturing operations and quality control regulations during installation of power supply systems, lighting, electrical heating facilities agriculture.</p> <p>PC 2.1.8. Applying the basics of metrology, electrical measurements, standardisation, certification and quality control when electrification and automation of agriculture.</p> <p>PC 2.19 Study methods of assembling electrical circuits, measurements, determining their conformity with the applicable specifications and standards.</p> <p>PC 2.20. Carrying out Assembly of deconstruction work in accordance with the nature of the connection details</p> <p>PC 2.21 Use polijazychija in their professional activities as a way of grasping the scope of expertise</p> <p>PC 2.22 Maintaining a healthy lifestyle</p>
			<p>151803 3 Electrical technician</p> <p>PC 3.1.1. Implementation of efficient electrification and automation of production processes with the choice of optimal parameters of electric circuits.</p> <p>PC 3.1.2. Compliance with the requirements of the law on records management of the Republic of Kazakhstan in the existing document production.</p> <p>PC 3.1.3. Working knowledge of the basics of the technological operations quality control works when cultivating crops, advanced technologies of production and preparation of forages and livestock.</p> <p>PC 3.1.4. Working knowledge of the regulatory legislation of RK on labour, occupational safety rules and regulations and the environment.</p> <p>PC 3.1.5. Working knowledge of modern ways and means of installation, adjustment and operation of power installations, automation and systems management.</p> <p>PC 3.1.6. Skills selection of electrical equipments and means of automation.</p> <p>PC 3.1.7. The maintenance and repair of devices rural electric networks, transformer substations, applying rules for their design and operation of irradiating installations, devices and means of automation of jelektooborudovanijami used in agriculture.</p> <p>PC 3.1.8. The production installation, maintenance, repair and adjustment of agricultural power, lighting and automation of</p>

		<p>electrical installations and parameters of electrified and automated agricultural technological processes, machines and installations.</p> <p>PC 3.1.9 View of the modern world and awareness of themselves and their place in society.</p> <p>PC 3.20 Understanding of the underlying economic, menezhdementa and marketing in electricity industry.</p> <p>ПК3.21 Knowledge of rights in professional activity.</p> <p>ПК3.23 Achieving cultural competence as abilities necessary for a responsible decision professional tasks.</p> <p>PC 3.24 Implementation of information collection, analysis and processing of social and political data necessary for solving economic challenges in their professional activities..</p>
		<p>151800 4 Junior Electrical Engineer</p> <p>PC 4.1.1. Working knowledge of the methodology of calculation and selection of energy saving installations, electrical technologies, based on the use of alternative energy sources.</p> <p>ПК4.1.2. Compliance with the requirements of the electricity industry guidance documents (CODES, PTB, FSP, IHPE).</p> <p>ПК4.1.3. Working knowledge of the agrarian law standards and their introduction into the processes of agricultural production;</p> <p>PC 4.1.4. Application of methods of feasibility of use of electric equipment and electrical technologies in agricultural production.</p> <p>PC 4.1.5. Perform installation, adjustment, repair and maintenance of RZA, automation and protection from short circuits.</p> <p>PC 4.1.6. Working knowledge of the methods to calculate and selection of equipment, RZA, automation, protection from short circuits using mathematical modeling and software calculation;</p> <p>PC 4.1.7. Working knowledge of the means of selection methods of reliability in electrical networks and redundant power supplies of agricultural consumer;</p> <p>PC 4.1.8. Organization and application of new technologies for installation, commissioning, repair and maintenance of farm power, lighting and automation of electrical installations;</p> <p>PC 4.1.9. Working knowledge of the basics of organizing and managing the production team system preventative maintenance and management of electric power equipment and automation tools for agricultural purposes.</p>

5. Explanatory note to the plan of educational process

The structure plan of educational process on the given speciality is in compliance with the requirement of article 56 of the Law of the Republic of Kazakhstan On Education and curriculum models attached to the State General Mandatory standards of technical and vocational education.

Plan of educational process reveals the structural content of vocational training, the amount of training time for the modules and disciplines, the sequence of learning modules on training courses.

The contents and the names of the mandatory subjects are provided in block "General Educational Disciplines" in the amount of training time 1448 hours and shall be determined according to State Standards for general secondary education.

General humanities and economic disciplines are implemented in preparing mid-level professional taking into account peculiarities of the speciality **"Electrification**

and Automation of Agriculture."

This educational program is distinguished by practical orientation of its professional training modules. Therefore, in educational programs special modules and industrial training are conjoined. That is, relevant topics of industrial training are included in the professional modules.

The structure of the plan of curriculum of professional training provide for:

- 1) study of professional and specialty modules;
- 2) perform laboratory and practical classes on general professional and specialty modules;
- 3) industrial training and professional practice;
- 4) perform coursework and written qualification (graduation) work.

Laboratory and practical classes and training can be organized on the basis of training and production workshops, educational and training sites as well as directly in the workplace and organizations in the field.

Professional practice is carried out in the respective organizations, workplaces, provided by employers on the basis of the Treaty, and is aimed at the formation and consolidation of professional competencies. Course projects (works) are treated as a type of academic work on obshheprofessional'nym and the special modules and executed within the training time for their study. Number of course projects (works) in a semester is not more than one. Additionally, it is allowed to schedule one term paper (draft).

Duration of technological (pre-diploma) practices determined by educational institutions on the development of the business training programmes, depending on the complexity of the speciality at no more than 8 weeks. In this regard, the duration of the elaborators of technological practices in this curriculum are defined within 8 weeks.

In order to take account of regional specificities and requirements of employers to training in the specialty, learning modules or subjects defined by educational organizations is provided for.

To determine the quality of acquisition of the educational programmes by students, the curriculum provides for interim and final assessment.

Intermediate assessment is envisaged for all disciplines and modules, and its basic forms are: exams, tests, review works.

Intermediate certification in general educational disciplines provides examinations in accordance with State Standards for general secondary education.

The number of exams, tests and tests on Humanities, economic disciplines, obshheprofessional'nym and professional modules is determined on the basis of the requirements to the level of knowledge, skills and competences required of the trainee.

Tests and tests are carried out at the expense of training time for the study of this discipline (module), exams-deadlines for intermediate certification.

As a result of interim certification for a modular curriculum and passing the qualification exam for working professions which includes professional readiness level assessment and award students are assigned to the achieved vocational qualification level (category, class, category)

Final assessment of students of institutions of technical and vocational education include:

- ~ assessment of students in educational institutions;
- ~ assessment of the level of professional skills and qualifications (for the high levels of qualifications).

Final assessment of students in educational institutions is carried out to determine the level of acquisition of educational programs students according to the results of a full course of study.

Possible forms of final assessment of educational institutions for follow-up completion of educational programmes: delivery of final examinations for professional and special modules or the performance and protection of written qualification (diploma) work with final certification exam for one of special modules.

Evaluation of the level of professional skills and qualifications (hereinafter OUPPK) on specialties:

- 1) theoretical test on the subjects (modules) determining vocational training;
- 2) performing practical tasks according to levels of qualification.

The amount of training time for final certification identified no more than 2 weeks. Of them on the Organization and conduct of OUPPK 12:00 are provided for every kind of qualification. When designing the work plan of educational process organization education can schedule amounts of teaching time.

Curriculum

The section "Curriculum" is one of the most important sections of the educational program and includes curriculum and an explanatory note to the curriculum.

The curriculum is developed taking into account the continuity of skill levels (fixed level, mid-level specialist, applied Bachelor's degree).

The curriculum governs the structural content (list) of training programmes for the modules and practice; forms of control; the amount of training time (hours), including the study of subjects and modules on a semester basis (table 4).

6. Program structure

The section "structure of the program contains a list of training modules, training objectives and procedure for the formation of basic competencies (table 5).

Table 5. Form the structure of the educational program

Professional competence	Subjects/modules	Learning goals			Code of generated basic competence
		Knowledge	Skills	Skills	
General educational modules					
General humanities modules					

PC 2.2.1 Use multilingual space in their professional activities as a way of grasping the scope of expertise	Professional (Russian)Kazakh language (in groups with non-Kazakh language of instruction): The syntax of the Kazakh language. Speech development. Terminology. Business correspondence in Kazakh language. Technology transfer (with dictionary), professional communication.	The State language and the possession of lexical (1200-1400 lexical units) and grammatical minimum required for reading and translation (with dictionary) texts of professional orientation; Terminology,	Competent use of professional vocabulary, to be able to apply knowledge of Kazakh and Russian languages in their professional activities;;	Communication in the official language to work in the sphere of their professional activity	BC 1-6
PC 2.2.2 Use multilingual space in their professional activities as a way of grasping the scope of expertise	Professional foreign language: Lexico-grammatical material, required for professional communication; different types of speech activities and forms of speech (spoken, written, monologic, Dialogic); technology transfer of professionally oriented texts.	Lexico-grammatical material, necessary for professional communication;	Differentiate between types of speech activities	Distinguish between Forms of speech (spoken, written, monologic, Dialogic)	BC 1-6
PC 2.2.3 Maintaining a healthy lifestyle	Physical culture	- the basics of a healthy lifestyle, the regularities of human life of the organism, ways to maintain and promote health	- physical education and sports skills of self-improvement;		BC 1-6
PC 3.2.1 Understanding of the underlying economy, management and marketing in electricity industry	Essentials of Economics, management and marketing	vocational and practical activities in organizations. Essentials of Economics, modern methods of production management, foundations of entrepreneurship in the professional sphere,	apply the theoretical knowledge in addressing practical professional activity	use economic information necessary for orientation in the professional field	BC1-7

		framework for the analysis of industrial and economic activity of the enterprises of the Agrarian and Industrial Complex			
P C 3 . 2 . 2 Knowledge of rights in professional activities	Fundamentals of law in industries	knowledge about the basic provisions of legal relationships in the industry; branches of law; to formulate an idea of the law, the State and the role of law in life. the basics of the legal doctrine of State; rights, freedoms and duties of man and the citizen, the mechanisms for their implementation; system of public authorities; legal and moral-ethical norms in the sphere of professional activity; legal responsibility of employees in the workplace.	work with a book (find information, highlight the main fragments to compare, make abstracts and reading plan, highlighting the semantic part); -own speech culture; -competently speak on legal themes;	display their perspective on issues of law;	BC1-6
Qualification: 151801 2 – Electrician					
Basic general professional modules					
PC 2.1.1. Simulation using PC technical calculations connected with design elements of an electrifying production processes, maintenance and repair of machinery and equipment	Simulation of electrical circuits using software	concepts: drawing, sketch, admission, landing, section, section, General view, top view, side, dimensions according to GOST formats, types of projections	run labels, drawing paths, read assembly drawings and diagrams, geometric constructions, execution	use standards when making drawings; implementation of technical drawing, drawings, sketches, details of the cuts, sections.	BC 1-6
PC 2.1.2. The use of measuring and regulation of technological processes	Analysis of the electric system, electronic engineering and control their functions	Basic electrical laws, symbols of the elements of electrical circuits, processes in electrical circuits, modes of electric circuits, destination, ways of incorporating measuring devices,	collect electrical circuits, calculate parameters of AC and DC circuits, linear and non-linear electric	use measuring instruments for measuring electrical quantities. Independent sources of	BC 1-7 BC10

		<p>resistance of wiring materials from a variety of factors, the electrical conductivity of dielectrics, dielectric strength dependence of various factors, factors influencing the electric strength, accuracy of measurement; error measures and measuring instruments, accuracy classes of measuring devices and their characteristics. Information about digital measuring devices of their classification, safety precautions when performing the dimension and build circuits, methods of measuring capacity in single-phase and three-phase circuits, how to convert the measured values in digital form; operating principle of device characteristics voltammetric and basic parameters of elements of electronics: components, principles of building devices model sites and schemes of electronic devices used for electrical equipment, the principle of construction and the operation of typical schemes of generators and pulse devices, multivibrators, triggers, harmonic generators, construction and principle of operation</p>	<p>circuits, adjusting parameters and modes of operation of electrical circuits, Giving characteristic depending on the alloy composition, conducting materials, collecting transformers, measuring current and voltage in DC and AC currents, measuring resistance by ohm, megohmmeter, ammeter, voltmeter, single and double bridge, measuring parameters of inductors and capacitors; use devices and perform accurate scheme of inclusion. the use of use of electronic multi-profile electronic multimeters, digiscope</p>	<p>of information on the latest developments in electrical engineering, in the selection of measuring equipment when performing simple security settings line; measurement of resistance by ohm, megohmmeter, ammeter, voltmeter, single and double bridge; apply safety rules for executions measurements. the use of electronic multi-profile electronic multi meters, digiscope</p>	<p>БК 1-7 БК10</p>
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		currents digiscope and registering devices, analog electrical measuring instruments, general information about pulse counters, descrambler, microprocessors, register and allocator;			
PC 2.1.3 Diagnostics of electrical machines, transformers and electrical materials used in them.	Diagnosis of electric machines and apparatus	- Working principle and device of machines of direct-current. Basic electrical laws applied to the theory of electrical machines. Excitation system of machines of direct-current. Magnetic circuit DC machines. DC generators and their characteristics. Device and operation of transformers. Types and classification of transformers. Theory of single-phase transformer. The main groups of connections of three-phase and single-phase transformers. Transformer voltage regulation when disconnected from the network transformer under load. The principle of operation of the device for regulating the voltage under load.- Principle and device of synchronous machines. Principle and device of machines of alternating current. Device and the operating principle of synchronous generators. Elements of design: stator, rotor, Exciter explicitly pole and non-polar synchronous generators. Single-	- definition of electrical materials on their properties; -explanation of the need to use electrically conductive materials -entity and switching skills; -disassembly and Assembly machines; -start up, change the direction of rotation of DC motor -the main differences of electrical machines and transformers - workflow transformers; -mode of operation of the transformer; -three-phase transformer connection groups schemes - principles and devices of machines of alternating current; -calculation and implementation of winding of machines of	start up DC motors, synchronous and asynchronous motors, use electrical materials Use of dielectric materials; perform selection of the measuring devices when configuring and protection of transformer and motor; apply safety rules by manufacture of works; and resistance measurement technology of grounding devices	BC 1-7 BC10

		<p>phase winding. Three-phase winding. Excitation systems of synchronous generators and circuits. Excitation of synchronous generators: native excitation with agitation from semiconductor and mechanical rectifier working principle of the synchronous motor.</p> <p>S y n c h r o n o u s m i k r o m a s h i n y . Synchronous gear. Reactive synchronous motor, a device torque.</p> <p>-classification of electrical materials-classification of tool steels, their values, working environment, tools, and value properties of alloying elements; properties, marking according to GOST and scope;</p> <p>-basic types of thermal, chemical and heat treatment of metals; -types of alloys of non-ferrous metals, light</p> <p>-classification of electrical materials-classification of tool steels, their values, working environment, tools, and value properties of alloying elements; properties, marking according to GOST and scope;</p> <p>-basic types of thermal, chemical and heat treatment of metals; -types of alloys of non-ferrous metals, light alloys, powder materials, anti-friction device</p>	<p>alternating current; - m e a s u r e resistance of earthing devices and shunt cable lines</p>	<p>подбор измерительных приборов при настройке и защите трансформатора и двигателя; применять правила техники безопасности при производстве работ; технологию измерения сопротивления и заземляющих устройств</p>	
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		and principle of action of transistor logic elements and integrated circuits, powder materials, anti-friction device and principle of action of transistor logic elements and integrated circuits			
Professional modules					
PC 2.1.4. Working knowledge of electric load methodology for entering agricultural consumers, the methodology of choice sections inside wiring and overhead power lines. PC 2.1.5 Working knowledge of the methodology bases the electrification of agricultural production devices, principles of action, the main characteristics and methods of selection of electrical equipment and automation tools.	Maintenance of electrical equipment and automation tools	-light industry standards requirements; schema automation and centralization of production; lighting installations-placing fixtures and design in guiding and irradiated space; -types of drives for the most widely used in agricultural production; -transients when designing actuators-flow production lines; -the economic importance of the right choice of electric motors for power at different modes of operation; -the energy performance of different actuators; the notion of closed networks; basics of electrical safety	hold rasc h et m o s h n o s t i j e l e k t r o t o p i t e l ' n o g o k o m f o r t e q u i p m e n t ; to calculate and perform selection of lighting and irradiating installations; apply the techniques of modern choice, remember the theoretical recommendations and apply them in practice; Read start-up scheme of asynchronous engines; apply the principles of designing electric drives in General; perform the calculation parameters and selection of MAE; Adjust power boilers; observe electrical safety	assist with injury; measurements of illuminance and irradiance	BC 1-5; BC 10; BC 15
PC 2.1.6 Working knowledge of electric load methodology for entering agricultural consumers, the	Maintenance and provision of electricity for agriculture	technological process of production and consumption; -types of power plants and substations; -transmission and distribution of electricity; -nominal	perform adjustment electrical equipment electrical networks and substations, electrical	determine valid voltage, voltage deviation table be, to determine	BC 1-10; BC 15-17;

methodology of choice sections inside wiring and overhead power lines	Обслуживание и обеспечивание электроэнергией сельское хозяйство	parameters of electrical installations; -Mark wires and cables, choose their sections on heat; -installation of internal transactions, the design supports, insulators; -determine the power and energy loss; -the definition of allowable losses tension; -the concept of closed networks; electrical safety basics.	maintenance, perform current electrical equipment; -be able to prokladovat' the wires and cables, define the cross-section of cables and wires, raschitovat' current loads, to observe electrical safety	the optimal number of transformer substations. rendering assistance in injury	
Qualification: 151801 2 – Electrician					
Common professional modules					
PC 2. 1.6 Modeling using computers, technical calculations, design elements of an electrifying production processes, maintenance and repair of machinery and equipment	Simulation of electrical circuits using software	-safety equipment when working on a computer; -composition of the personal computer; -the composition and structure of PC software; -principles of the desktop window Editor; -window elements, Excel worksheet functions	-work with the main menu, with Windows; toolbar with conduit	work in Paint; -create a document, format text, work with Excel tables; - create diagrams to define parameters of the regression equation. Plot diagrams with AutoCad graphical editor	BC. 1-7
PC 2.1.7. The use of measuring and regulation of technological processes	Analysis of the electric system, electronic engineering and control their functions	-Basic electrical laws, symbols of the elements of electrical circuits, processes in electrical circuits, modes of electric circuits, destination, ways of incorporating measuring devices, resistance of wiring materials from a variety of factors, the electrical conductivity of dielectrics, dielectric strength dependence of various factors, factors influencing the electric strength,			BC . 1-10

		<p>accuracy of measurement; error measures and measuring instruments, accuracy classes e measuring devices and their characteristics. Information about digital measuring devices of their classification, safety precautions when performing the e dimension and build circuits, methods of measuring capacity in single-phase and three-phase circuits, how to convert the measured values in digital form; operating principle of device characteristics voltammetric and basic parameters of elements of Electronics: components e. principles of building devices model sites and schemes of electronic devices used for used for electrical equipment, the principle of construction and the operation of typical schemes of generators and pulse devices, multivibrators, triggers, harmonic generators, construction and principle of operation amps constant currents digiscope and registering devices, analog electrical measuring instruments, general information about pulse counters, descrambler, microprocessors, register and allocator;</p>			
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<p>PC 2.1.2. Design and construction of electrical installations, electro-technological processes when choosing optimal solutions.</p> <p>PC 2.1.3. The use of electrical and structural materials for the construction, installation and operation of electrified and automated agricultural installations.</p> <p>PC 2.1.4. Analysing the causes of malfunctions and failures of electric machines and apparatus, with the recommendation of measures to improve operation reliability.</p>	<p>D i a g n o s i s of electrical equipment and apparatus</p>	<p>principle and device of machines of direct-current; the basic laws of electrical engineering applied to the theory of electrical machines; sistemuvobuzhdenija DC machines; magnetic circuit DC machines; DC generators and their characteristics; device and operation of transformers; types and classification of transformers. Theory of single-phase transformer; the main groups of connections of three-phase and single-phase transformers; -operation principle and device of s y n c h r o n o u s machines; principle and device of machines of alternating current; device and the operating principle of synchronous generators. specific designs and methods of calculation of parts and mechanisms of machines for strength, rigidity and stability with different kinds of load (simple and complex); -basic concepts and axioms of statics, communications and reactions; system randomly spaced and parallel forces; -basic concepts of kinematics; -the simplest movement of a rigid body; basic concepts about the resistance of materials; -mechanical</p>	<p>-disassembly and Assembly machines; -start up, change the direction of rotation of DC motor - workflow transformers; -mode of operation of the transformer; and choose a payment s c h e m e (m o d e l) mechanism and to undertake relevant model calculations for the industry in the design of machine elements; -analyse the working conditions of the simplest mechanisms and machines.</p>	<p>distinguish from machinery to electrical transformers, to conduct the analysis of commutation; solve design problems using methods of technical mechanics;</p>	<p>B C 1-10</p>
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		transmissions; -bearing, supporting, hull and elastic parts; connection of machine parts;			
Professional modules					
PC 2.1.6. Perform maintenance and repair wirings, lighting and irradiating installations, devices and means of automation of electrical equipment used in agriculture. PC 2.1.7. Working knowledge of the techniques of performing manufacturing operations and quality control regulations during installation of power supply systems, lighting, electrical heating of objects of agriculture.	Maintenance of electrical equipment and automation tools	-light industry standards requirements; schema automation and centralization of production; lighting installations -placement of fixtures and design in guiding and irradiated space; -types of drives for the most widely used in agricultural production; -transients when designing actuators-flow production lines; -the economic importance of the right choice of electric motors for power at different modes of operation; -the energy performance of different actuators; the Organization and content of scheduled preventive work; Then the repair of electrical equipment; the basic amount of work when repairs; Norms of consumption of spare parts when repairing equipment for various purposes; Troubleshooting; How to repair the elements of air and cable lines; technology of repair of electric machines; repair technology of power transformers, ROUX and higher voltages up to 1000 v; technology repair inside wiring of power and lighting networks.	-measurements of radiant light; make a calculation and selection of lighting and irradiating installations; to repair wiring and elements VL; repair units and spare parts for electrical machines; repair and replacement of components and parts of power transformers; repairing equipment EN voltage up to 1000 v and above	apply them in practice, selection of modern technique, theoretical recommendations schema start asynchronous motors. assess the technical condition of the electrical equipment; electrical fault mine op; Troubleshoot within a time limit set by the regulations;	B C 1-10

PC 2.1.7. Working knowledge of the techniques of performing manufacturing operations and quality control regulations during installation of power supply systems, lighting, electrical heating of objects of agriculture.	Maintenance and provision of electricity for agriculture	technological process of production and consumption; -types of power plants and substations; -transmission and distribution of electricity; -nominal parameters of electrical installations; -Mark wires and cables, choose their sections on heat; -installation of internal transactions, the design supports, insulators; -determine the power and energy loss; -the definition of allowable losses tension; -the concept of closed networks; the notion of closed networks; basics of electrical safety.	- perform adjustment electrical equipment electrical networks and substations; maintenance of electrical equipment; perform current electrical equipment; -prokladovat' wires and cables. observe electrical safety	identify the wires and cables, to determine the cross section of wires and cables, providing assistance with injury.	B 1-10 C
PC 2.1.8 Applying the basics of metrology, electrical measurements, standardisation, certification and quality control when electrification and automation of agriculture	Rules of standardization and Metrology in agricultural production processes	-Category standards. The importance of international standardization in the development of relations between States. -Basic provisions and definitions in the area of standardization, its role in improving the quality of products- oboznochenie permissible deviations in drawings	-classification of measuring instruments. Basic metrological performance measurement tools - micrometer provisions -classification of measuring instruments. -Selection of measurement errors	Use the devices for relative measurements	B 1-10 C
Mid-level specialist					
Qualification: 151803 3 – Electrical technician					
Common professional modules					
PC 3.1.2. Compliance with the requirements of the law on records management of the Republic of Kazakhstan in the existing	Record keeping in the State language	- business correspondence in Kazakh; structure of the service document, post the structure, responsibilities, technology documentation using technical means;	- prepare and execute administrative-organizational documents, official correspondence in the State language; -work with documents	-work with documents from the moment they arrive prior to execution; work with reference literature.	BC 1-6; B 9-16; C

document production			from the moment they arrive prior to execution; work with reference literature.		
PC 3.1.4 Working knowledge of the regulatory legislation of RK on labour, occupational safety rules and regulations and the environment	Basics of Agronomy and animal husbandry	-law on land-on improving soil fertility, growth and development of agricultural plants, on the properties of organic and mineral fertilizers, influencing the increased crop yields - The cost effectiveness of various treatment techniques	- calculate the norm of fertilizers under agricultural crops to improve soil fertility, raise productivity and improve the quality of crops; - The basic patterns of growth and development of agriculture, their relationship to each other.;	Be card technology	BC1-6; BC 11-18;
Professional modules					
PC 2.1.5 Working knowledge of electric load methodology for entering agricultural consumers, the methodology of choice sections inside wiring and overhead power lines	Maintenance and provision of electricity for agriculture	influence of electric power quality receivers to work and activities to improve power quality indicators; security of supply requirements of consumers first, second and third categories; elements of technique of high voltages in power supply systems; methods for testing the insulation of high-voltage electrical equipment in electrical networks; purpose, scope and rules of testing the insulation of various types of electrical equipment; power supplies and equipment for testing the insulation; Overview of	control power quality indicators; determine the quality of electric energy and their normative values; perform the test pass and core isolation porcelain insulator; define internal overvoltage, atmospheric; implement surge protection; perform selection and justification electricity scheme and the electrical equipment for	determine valid voltage, voltage deviation table be, to determine the optimal number of transformer substations. rendering assistance in injury; read schema test facilities; be a PivotTable to the protective switching equipment and conducting production.	BC 1 - 18;;

		<p>overstress; internal and atmospheric overvoltages; types of surge arresters and installation on step-down substations, main assignments, complete transformer substation and distribution devices of high voltage; Rod lightning protection of substations, buildings and constructions; protection of overhead lines.</p>	<p>the project; to calculate electric loads on the sides and 6 0.4-10 kV, lighting loads for specific power; reactive power compensation to perform on the sides and 6 0.4-10 kV; perform selection of power transformers (t e c h n o - e c o n o m i c comparison of identified options is not required); perform the calculation of short-circuit currents on 6-10 kV substation (s t a t i o n) factory, with tires which receives power p r o j e c t e d object short-circuit currents on side 6-10 kV shop en, short-circuit currents on 0.4 kV substation to the plant; p e r f o r m input cable, p r o t e c t i v e switching equipment and wiring products for 0.4 kV; perform the substantiation rates: kV; CLV; KP; KZ (temperature,</p>	
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			<p>taking into account the mode of operation of the receiver, the number of conductors and requires overload protection network);</p> <p>Select the slot input and sectioned;</p> <p>selection of protective equipment and wires to one engine and one node;</p> <p>perform selection and testing of high-voltage equipment, bus 0, 4kVi6-10, measuring current and voltage transformers;</p> <p>perform calculation of relay protection, earthing device and plant substation.</p> <p>perform protect electrical equipment from surges of electrical networks;</p> <p>define step voltage;</p>		
<p>PC 3.1.5 Working knowledge of modern ways and means of installation, adjustment and operation of power</p>	<p>Maintenance of electrical equipment and automation</p>	<p>technological bases of electric and electrical equipment for agricultural production; action principle, basic characteristics and selection methods of electrical equipment;</p>	<p>to calculate e lighting method for Pcs, point method; to be able to navigate the principle actions and schemes of</p>	<p>design of electric lighting; selection of electrical equipment and automation tools and</p>	<p>B C 1 - 18;</p>

installations, automation and systems management	Обслуживание электрооборудования и средств автоматизации	rules of operation of electroinstallations; know the use of electrical equipment building machines and mechanisms: concrete mixers, lifts, vibrators. electrical equipment and electrical networks of civic buildings; protection devices; receivers of electricity residential buildings;	electric and electrical equipment agricultural processes; Select the device control protection of residential and public buildings; perform calculation of lifts; to calculate the power required to perform selection of electric engines, machines, magnetic starters, thermal relays; complete register of enterprises; define the cross-section of the wires and cables; carry out the selection and development of control scheme; to calculate lighting lines; arrange the graphics part of the course of the project.	organize their set-up and operation; describe the object design; draw up a table of source data; perform the substantiation and choice of electric drive; apply rules on TB and STDS;	Б К 1 - 18;
PC 3.1.6. Skills selection of electrical equipments and means of automation	Automation and mechanization of production processes	the main means of mechanization of technological processes of production;	-reasonably choosing and using modern electrical technology-basics of electric and electro mechanical systems design; -basic requirements standards and	assess the technical condition of the power supply; define the development prospects of power system of agricultural enterprises and settlements	BC1-18

			rules of electrical installations (PUE) in the production and distribution of electricity, providing reliable and economical electricity for rural consumers, as well as key technical and economic calculation methods and selection of electrical installations and electrical supply schema elements, methods and means to ensure the reliability and quality of electricity supply, reducing energy losses;	оценить техническое состояние электро-снабжения; определить перспективы развития системы электро-снабжения сельскохозяйственных предприятий и населенных пунктов.	
PC3. The production installation, maintenance, repair and adjustment of agricultural power, lighting and automation of electrical installations and specified options electrified lines and automated agricultural technological processes, machines and installations	Installation, maintenance and repair of electrical installations	General issues of installation of electrical equipment; regulations and departmental instructions for installation of electrical equipment; the basic normative documents, technical, installation, construction documentation; hidden wiring requirements; technological operation mounting flush mounting external transactions, transactions in mounting boxes and trays	differentiate between installation and electrical wires, cable products, conductive materials and articles; perform installation of open and closed transactions, gasket wirings on strings, in trays, tubes; perform installation transactions in production premises; to calculate the lighting current	mounting fixtures; installation electric wiring; preparation of slopes wirings; stripper, punchy, mounting works; connect conductor wires and cables.	BC1-18

		<p>mounted motors. three - phase asynchronous electric motors of alternating current; construction, marking, types of electric motors; the designation of the conclusions of the EM windings; classification of EM; the main types of EM; storage, loading, transportation ad; supporting execution grounds. anchor base, their execution, inspection of Foundation under installation. tehnolgiju installation of control equipment and automation; non - automatic control equipment. appointment and operation of the switch, universal switch, relays, starter fuse, thermal relays, circuit breakers and their inclusion; the appointment of a management station; installation requirements, basic information; claim codes to ground electrical installations; materials for earthing; installation technology of grounding devices; device and circuit of electrical installations for heating air, water, steam; jeлектроventiljatornye and nowadays such installation; installations for heating of the soil; the pra requirements,</p>	<p>network load and voltage loss; perform reconciliation of the shafts of electric motors, strengthening of foundation bolts; apply a tool for reconciliation; perform installation of electric motors; installation of control equipment and automation; perform the installation of control equipment and protection; perform installation of automation; perform the calculation and the choice of remedies and marks wires; perform installation of earthing devices and car installation grounding devices, and car, installation of earthing, zero protective conductors; perform calculation of earthing device production facility; installation of heating installations, installation of heating installations;</p>	<p>монтаж светильников; монтажа электропроводок; подготовки трасс электропроводок; разметочной, пробивной, крепежных работ; соединять жилы проводов и кабелей.</p>	БК1-18
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		classification of ballasts; failure device and mounting household lighting and auxiliary premises; preparatory work, technology installation fixtures, car and grounding solidly grounded and insulated neutral.	of electroheating installations installation lighting and irradiating installations, perform the calculation and selection of lighting fixtures.		
Qualification: 15180* * – Assistant electrician					
Basic common professional modules					
PC 4.1.1. Working knowledge of the methodology of calculation and selection of energy saving installations, electrical technologies, based on the use of alternative energy sources.	Unconventional energy sources in agriculture	Arguments for renewable electricity; advantages and disadvantages of solar power plants; -application of wind energy; -classification of wind turbines; -the use of biogas; -the concept of geothermal installations.	use solar energy in agriculture; assemble and disassemble wind turbine solar scheme read; bioreactor scheme	assemble and disassemble wind turbine	BC1-28
PC 4.1.2. Compliance with the requirements of the electricity industry guidance documents (CODES, PTB, FSP, IHPE). PC 4.1.6. Working knowledge of the methods to calculate and selection of equipment, R Z A, automation, protection from short circuits using mathematical	Software when solving mathematical problems in electric power industry	mathematical foundations of optimization parameters and modes of electropower systems; mathematical programming techniques in electric power industry; linear programming in relation to the practical problems of electricity; the notion of exact and approximate methods for solving linear algebraic equations; the theory of duality in linear programming; the theory of directed graphs and uncirculated. the scope and basic techniques of decision; setting	solve math problems arising in the design and operation of electric power systems; analytically represent the configuration of electrical networks and their solution using Ohm's laws Kirchhoff and in matrix form; solve characteristic optimization problems: management of normal established regimes, planning and	be modified Zhordanov's table; mathematical models of equations be established regimes using matrix methods; perform a safety established modes of electropower systems using AKVIS RASTR and its applications..	B 1-22; C BC 24;

modeling and software calculation;		transport task in the field of electricity; Nonlinear program mirova nijapo stanovku of nonlinear programming tasks in the field of electricity; methods of finding the source of supporting plans; application of the method of Lagrange multipliers in the uncertain electricity challenges; theorem of Kuhn-Tucker Law; gradient optimization techniques; dynamic programming; geometric interpretation of typical tasks of dynamic programming method in electric power industry; functional equations; criterion programming; concepts of sustainability into "small" and "large"; the concept of static and dynamic stability; algebraic criteria for stability; repeated sensitivity optimization parameters and costs at the point of . minimum data to change; method of successive intervals; random phenomena and events; random variables; mathematical models of bounce and restorations; criteria for consent; theory of random functions. The Monte Carlo Method.	development of interconnection of electric power systems on different time perspective, etc.; be economical-mathematical models of linear programming problems; apply the simplex, graphical methods of solution; represent the inverse matrices in the form of pieces of double factors; to solve the task of transportation method; meet the challenges of the field of electricity with the use of dynamic programming; explore the feasibility of a model power (power transmission lines, transformer substations, etc.); define the criteria of similarity; is sled o vat's o raz mernosti; determine the values of the parameters and costs at the point of minimum		
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			target function; explore the technical and economic sustainability. apply Lyapunov method in solving electricity problems; use of probability theory and mathematical statistics in electric power tasks; to collect statistical data on denials and vosstanovlenijam; define laws of distribution of random variables and their numeric characteristics; to determine the reliability of electric power systems of the various schemes, the timing of their recovery or no recovery and the probability of their failure..		
PC 4.1.3. Working knowledge of the agrarian law standards and their introduction into the processes of agricultural production;	Agrarian law standards in agricultural production processes	normative legal acts, regulating relations in agriculture; scientific achievements in the field of jurisprudence and the basic directions of development of agrarian law	analyze the normative acts, regulating relations concerning the ownership, enjoyment and disposition of property	navigate the articles of the civil and penal codes, the law on administrative liability for legal violation	BC1-6
PC 4.1.4. Application of methods of feasibility of use of electric equipment and electrical	The account of the electric power system on the basis of economic management	the aims and objectives of the reform of electric power industry of the Republic of Kazakhstan; - organizational	plan and predict demand for electrical and thermal energy; count basic technical-economic	skills of calculating the strength and structure of the staff of the Organization;	BC 1-6;

technologies in agricultural production..		structure of the Office sector and management of energy companies; -basic economic categories and concepts; -the basic techniques of economic evaluation of projects; -the basics of business planning of investment projects; -the basics of bookkeeping and accounting; -Basic risk assessment methods;	indicators; - Schedule repairs equipment; -Define cost of production elements; -to assess the financial soundness and economic viability of the project.	skills to develop a business plan and a summary of the project; -skills in estimating the cost of design works; -electricity tariff calculation skills.	BK 1-6;
PC 4.1.5. Organization and application of new technologies for installation, commissioning, repair and maintenance of farm power, lighting and automation of electrical installations	Installation, adjustment devices of relay protection and automation systems of power supply	place and role in the system of preparation of specialists of agriculture. a brief sketch of the development of automation of agriculture; regional characteristics of automation of agricultural production in the light of the environmental problems; automatic objects overview systems elements and facilities management in agricultural production; basic concepts and principles of automatic control systems (ACS); mathematical description of linear continuous control systems; stability conditions of automatic control systems; types of automation of agriculture; technical automation; Automation of technological processes, storage of agricultural products; in feed production; water and irrigation; in the poultry industry;	to distinguish perceiving elements and sensors; Comparing devices, specify the devices, amplifiers, actuators, relays, logic elements, regulators; justify and execute the Automation object selection; develop structural scheme of automation facility; develop functional and technical scheme of automation; the concept of electrical scheme; an automation system; explore the sensors and temperature regulators; explore the logical elements of automation;	perform installation of elements of automation (fuses, circuit breakers, magnetic starters, heat and intermediate relay, time travel (finite) switches (switches), buttons and controls); design protection or control panel object;	P C 4.1.7. Organization and application of new technologies for installation, commissioning, repair and maintenance of farm power, lighting and automation of electrical installations

		Techno-economic efficiency of automation of technological processes; in crop production, animal husbandry, poultry farming and reclamation; assigning static sensors and their characteristics; arrangements for the installation and commissioning of an automated management schemes; concerning labour protection and safety installation.	explore the two-step configuration, triple grating automatic control system; perform calculation of main parameters of reliability of automated control scheme schema; use relay and Automatics software.		осветительных и автоматизированных электроустановок;
PC 4.1.6. Working knowledge of the means of selection methods of reliability in electrical networks and redundant power supplies of agricultural consumer.	The determination of indicators of reliability and quality of electric power in power supply systems	questions on optimization of emergency and repair work modes power system reliability of power supply systems of industrial enterprise; basic definitions and indicators of reliability of power supply systems; • classification according to the degree of continuity of supply; quantitative characteristics of uninterrupted power supply systems; the amount of voltage in the power supply systems of industrial enterprises; main indicators of quality strains and their valid values. influence of voltage quality in electrical energy receivers work and technological installations; definition of economic loss when disconnecting the voltage in the power supply systems of industrial enterprises; ways and means to	to calculate reliability SES parallel or serial connection elements; to calculate reliability SES join "m n of calculation of reliability of SES with mostikovym type compounds, calculation of reliability of SES with the combined type of joints, calculation of reliability of redundant systems; perform quality control of voltage in the power supply systems of industrial enterprises; apply tools and devices for mass quality control	solve mathematical methods of calculation of reliability of power supply systems; determine the damage from violation of power supply; perform selection of technical means of voltage regulation;	Б C 1 - 28;;

		improve the quality of voltage in the electric industry;	voltage; to calculate the deviations of voltage in power supply systems; to calculate voltage fluctuation; perform calculations in nonsinusoidal power supply systems; to calculate voltage nessimetrii power supply systems; to calculate the reliability of power supply systems; perform selection branch on transformers; calculate the impact of battery installation of condensers for voltage level in power supply system; to calculate the reliability of electricity supply systems with successive elements, calculation of reliability of power supply systems with parallel elements.		
PC 4.1.7. Organization and application of new technologies for installation, commissioning	Installation, maintenance and repair of electrical installations	place and role in the system of preparation of specialists of agricultural production. a brief sketch of the development of automation of	to distinguish perceiving elements and sensors; Comparing devices, specify the devices, amplifiers,	perform installation of elements of automation (fuses, circuit breakers, magnetic starters,	BC 1 - 28;

repair and maintenance of farm power, lighting and automation of electrical installations;	Монтаж, техобслуживание и ремонт электроустановок	agriculture; regional characteristics of automation of agricultural production in the light of the environmental problems; automatic objects overview systems elements and facilities management in agricultural production; basic concepts and principles of automatic control systems (ACS); mathematical description of linear continuous control systems; stability conditions of automatic control systems; types of automation of agriculture; technical automation; Techno-economic efficiency of automation of technological processes; assigning static sensors and their characteristics; arrangements for the installation and commissioning of an automated management schemes; concerning labour protection and safety installation.	actuators, relays, logic elements, regulators; justify and execute the Automation object selection; develop structural scheme of automation facility; develop functional and technical scheme of automation; the concept of electrical scheme; an automation system; explore the sensors and temperature regulators; explore the logical elements of automation; explore the two-step configuration, triple grating automatic control system; perform calculation of main parameters of reliability of automated control scheme schema; use relay and Automatics software.	heat and intermediate relay, time travel (finite) switches (switches), buttons and controls); design protection or control panel object;	
PC 4.1.8. Working knowledge of the basics of organizing and managing	Managing structural subdivision of the Organization	ways of organizing production work in enterprises, especially in the power management; the quality management	to calculate the performance of the CTA; problem-solving situational	arrange production work station, line shop; participate in the analysis	BC1-6; BC11-14; BC16-28;

the production team system preventative maintenance and management of electric power equipment and automation tools for agricultural purposes.		system in electric power generation, management and; planning, organization of the work of the subdivision. the basis of the Board of a structural subdivision of the Organization in the electricity sector socio-economic characteristics of the communications industry and its structure; the economic characteristic of the communications industry and its features; types of segments of their characteristics and peculiarities; the essence, principles, methods of governance; types of organizational structures in the field of communications; types of business entities in the communications industry. classification of subjects of communication; features of the production process on the enterprises of the connection; kinds of production work at CTA; maintenance, development of the network accounting work; organizational and productive structure of the CTA; the essence and characteristics of modern management; features of management in electric power industry; the function	tasks by choosing the method of management effects; participate in monitoring observance of technological discipline, quality of work, participation in monitoring the effective use of technological equipment and electricity when implementing management solutions; work on the slave qualification of personnel; to prepare for upgrading electrical and electro mechanical equipment; plan the work of structural units; perform the calculation of indicators on the efficiency of production units, the use of main and auxiliary equipment; participation in the decoration of the sheet attendance and payroll officer; perform under the supervision of an employee who has the right to carry out the works of individual	of structural units in the Organization of the work of artists using a variety of techniques; technical documentation; planning work of structural units; to train and participate in meetings with the staff of enterprises and units, holding the head of the disciplinary interview with an employee of the organization who committed the disciplinary offence; describe problem situations in professional activity and elaboration of options for management decisions to resolve these problems.	BK1-6; BK11-14; BK16-28;
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		of management in the technology, management methods. communication in management; the quality management system in electric power industry; Organization of work of the MPC; the organizational structure of the energy economy of enterprises and organizations; Organization of work of structural units; main indicators of the effective use of technological equipment and electricity; the organization controls at production site; Organization of work on occupational safety at the production site; Organization of work related to the liquidation of emergencies; algorithm of decision-making; types of works on modernization of electrical and electromechanical equipment and examination of the means for their implementation, the development of technologies.	operations on introduction of new technology and development of advanced technologies to work on modernization of electrical and electro mechanical equipment, technological innovations and the development of advanced technologies; to work on the preparations for the tests, technical inspection and commissioning the newly installed or repaired electrical and electro mechanical equipment; perform the calculation of indicators on the efficiency of production units, the use of main and auxiliary equipment.	
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7. Content of the educational program

General Humanities

GHD 01 Professional Kazakh (Russian) language

Purpose: development of the intellectual, creative and cognitive abilities of students; development of pupils' interest to the study of Kazakh language, instil in pupils the moral, ethical, moral qualities, nurturing feelings of love for the Motherland; Mastering the reference office work in Kazakh language; language training of future specialists; formation of translation skills Kazakh to Russian, Russian to Kazakh language;

Introduction to the module: In order to not repeat every time the materials covered in school, new, fresh lexical materials are offered. Task of finding sustainable phrases, proverbs and sayings, synonymic row, words-antonyms, etc. from lexical texts, contained in the program depending on the content of each lesson, as well as the constant focus on the origin and etymology of the word develops cognitive and creative abilities, increases students' interest in language learning. Lexical materials should be related to such sectors as energy, manufacturing, industry. Because college student is a necessary cadre that will work in different spheres of domestic production in the future. For this reason, naturally, it will be interesting to get acquainted with information related to the industry in which the student will work. Throughout the training, giving communicative direction, targeting the ability to use knowledge of Kazakh language in practice, in professional specialization, in the course of employment, general outlook of the student is formed. In the course of comprehension of Kazakh language, educational components are also implemented. Along with this, through the study of Kazakh language great opportunities are provided for the formation of spiritual, moral and aesthetic senses of students, for their self-education.

GHD03 Professional foreign language

Objective: development of communicative competence in in the aggregate of its constituents.

Tasks:

- development of speech competence: skills in speaking, listening, reading, writing;
- development of language competence, the ability to communicate on the specialty;
- development of compensatory competencies – using synonyms, gestures, etc.;
- development of learning and cognitive competence - desire and ability to self-study of English.

The content of the educational program "Professional foreign language" is determined by the teachers independently in accordance with the objectives and with guidance by expected learning outcomes and assessment criteria:

Learning outcomes after successful completion of the module the learner	Criteria for assessment: learner should
PO 02 PC3.19 Can speak a foreign language in their professional activities to realize the scope of expertise	2.1. Understand the essence and the social significance of their future profession, demonstrate steady interest in it; 2. 2. Ability to organize the workplace; 2.3. master professional vocabulary; 2.4. perform work under the supervision of specialists of higher qualification; 2.5. possess computer methods for collecting, storing and processing of information; 2.6. be able to work in a team, communicate effectively with colleagues, management, consumers; 2.7. use of information and communication technologies to improve the professional activity; 2.8 possess a lexical (1200-1400 lexical units) and grammatical minimum required for reading and translating (with dictionary) texts of professional orientation;

	2.9 be familiar with terminology; 2.10 competently use professional vocabulary of foreign languages in their professional activities; 2.11 communicate in the foreign language for working within their professional activities.
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GHD 03 Physical culture

Purpose: The formation of physical culture of the students and their ability to realize it in their socio-occupational, physical and sports activities.

Tasks:

- Building desire for physical self-improvement and healthy lifestyle.
- formation of a system of theoretical knowledge and practical skills in the field of physical culture.
- ensuring the necessary level of professional readiness of future professionals, including physical fitness, performance, development of professionally significant qualities and psychomotor capabilities.
- use of means of physical culture for disease prevention, conservation and promotion of health, mastering the skills of self-control in the process of physical training and sports activities.
- the inclusion of trainees in active physical training and sport activities for the development of the values of physical culture and the acquisition of experience of its use in the full development of an individual.

Content:

Section 1. Track-and-field athletics

Track-and-field athletics in the system of physical education. Sprint - 60 m. Study of running techniques, low start. Starting takeoff, distance running, running in (finish). Special jogging exercises (running with high knees, tibia backwards bending, trotting, jogging). Alternating running (winders), repeated running, running with the acceleration from walking). Relay race: receiving and delivering baton, preparatory exercises. Techniques and tactics for short distances, as well as in a relay race.

Cross-country running. Techniques and tactics of running, start running on lowland sites, bends, running uphill and downhill, finish. Throwing grenades. Throwing technique, holding grenades, in-run. Long jump.

Section 2. Basketball.

Moving, running normal and attached steps, with the change in direction and speed, jumps, stops and turns. Ball possession: catching and passing on the ground and in motion. Chest pass with both hands, overhead pass, one-hand pass. Single-hand shoulder throws.

Elements of the game in defence and in attack, "fast-break", alignment and pulling the ball. How to counter the throw in the basket. Training and two- team game.

Section 3. Volleyball.

Playing technique. Stance, moving, technics of ball possession (lower straight, lower lateral transfer). Technique of ball possession (lower, upper reception). Elements of game techniques in offense and defense. Training and two-team game.

Section 4. Handball.

The rules of the game. Running in a straight line, with the change of direction. Catching the ball, shooting on goal. Practicing actions of players in defense and attack.

Section 5. Presidential tests

Acquaintance with the content of the Presidential tests, conditions of performing the exercises, and requirements for participants. Inspection and assessment of students' preparedness to pass the Presidential tests.

Learning outcomes: upon successful completion of this module the student	Assessment criteria: Student has to
PO 03 Is aware of the value of physical culture and the principles of a healthy lifestyle	1.1. understand the essence and social significance of physical culture in the profession, demonstrate a steady interest in it; 1.2. apply the basics of a healthy lifestyle; 1.3. explain the patterns of vital functions of human body; 1.4. apply the methods of maintaining and strengthening health; 1.5. to be able of self-improving in sports for physical fitness.

SED.00 Socio-economic disciplines

SED.02 Basics of economy, management and marketing

Purpose: To form systematic knowledge about the enterprise as a main economic agent of the modern economy, about organizational and economic fundamentals of operation and development in the current market conditions; knowledge about the marketing: to justify the need for marketing in the enterprise; to master the conceptual framework of the organization of marketing activities in the enterprise.

Objective: To study the organization of the production process, the composition of resources, indicators of their efficient use, pricing mechanisms, forms of remuneration.

Content of the discipline is conditionally divided into 3 following sections:

1. Basics of economics. The main provisions of the economic theory. The principles of the market economy. Economy and production.

2. Basics of management. Management cycle. Motivation and remuneration. Communications and business communication. Making decisions. Management styles and forms of power. Peculiarities of management in professional activity.

3. Basics of marketing. The process of marketing management. Marketing complex. Subject 3.3 Market research. Pricing and sales.

Learning Outcomes	Assessment criteria upon successful completion of this module the student has to:
LO 02 Formation of students' perceptions of market economy principles, team management functions and styles, marketing complex.	know: - main provisions of the economic theory; principles of the market economy; - current state and development prospects of the sector; - the basics of entrepreneurial activity in the sector; - mechanisms of pricing for products (services); - principles of the formation of the wage fund. Forms and systems of labor expense. - labor motivation; types of guarantees and compensations;

	<ul style="list-style-type: none"> - peculiarities of management especially in the field of agricultural mechanization; - management styles, forms of communication; principles of business communication in the team; - the nature, objectives, principles and functions of marketing, its connection with the management; - form of adaptation of production and sales to the market situation. <p>be able to:</p> <ul style="list-style-type: none"> - to explain the essence of the basics of the economy, advanced production management techniques; - to calculate the basic technical and economic performance of the organization; - to use in professional work methods of business and management communication; - to analyze the situation on the market of goods and services; - to apply the basics of the analysis of industrial and economic activities of agricultural enterprises; - to apply theoretical knowledge in solving practical professional tasks; - to use economic information for orientation in the professional sphere.
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SED.03 Basics of labor laws in the sector

Purpose: To introduce the learner with the basics of labor laws and legal relations between an employer and employees. To teach legal culture and legal awareness in the sphere of professional activity.

Objectives: To form knowledge and understanding of the basics of labor laws: The main provisions of the Labor Code of the Republic of Kazakhstan: the right to work, types of working time, and types of resting time. The employment contract: the content, types, grounds and procedure for termination of an employment contract. The procedure for employment, labor book, transfer to another job. The rights and obligations of the employer and the employee. Labor discipline. Types of rewards and penalties, the order of imposing and removal of sanctions. Grounds for legal and material liability, the procedure for its application.

Learning Outcomes	Assessment criteria
Upon successful completion of this module the student:	
LO 03 To be able to independently defend his rights in professional activities	<p>Has to:</p> <ul style="list-style-type: none"> - demonstrate knowledge of the basics of law in employment, at the conclusion of the employment contract; - focus on issues of legal regulation of relationship with the employer; - explain the importance of labor law in the formation of identity, citizenship and professional skills; - know concepts of law, freedom, human and civil responsibilities, mechanisms for their implementation; - explain the essence of the system of employees protection body (the government); - own the legal, moral and ethical standards in the sphere of professional activity; - explain the legal responsibility of employees in the workplace; - competently say and show his point of view on the issues of legal relations between employee and employer.

Higher level
1518012 – 2 Electric fitter (2 level of NQF)

BGPM. 00 General professional modules

BGPM.01 Simulate electrical circuits using software

Purpose: development of knowledge and skills needed to perform and read technical drawings, to draw sketches of parts.

Objective: drawing up design and technical documentation using software

Content of the module:

Section 1. Graphical design of drawings. Drawing as a document of the Unified system of engineering drawings. Drawing numbers and letters in a standard font. Individual graphical implementation of works

Geometric constructions in the performance of graphical works. Drawing of parts geometries through dividing the circle into parts and constructing conjugations and applying of dimensions.

Section 2. Projection of drawings. Types and rules of projection. Engineering drawing. Types of projection. Axonometric projection: dimetric, isometric.

Methods of imaging spatial forms. Sections. Marking sections in drawings. Cross sections. Types of cross sections and their marking. External, overlaid and open cross sections. Local and additional types.

Hatching of cross sections depending on the material of the detail. Tolerances of form and position of surfaces. The roughness of the surface. The dependence of the roughness on the type and method of the surface treatment. Marking of form deviations and surface roughness in the drawings. Intersections of surfaces. Methods for determining the line of intersection of surfaces: a method of auxiliary section plane, method of auxiliary circles. Exercises to determine the line of intersection of various geometric shapes. Drawing up an integrated drawing of training model with the implementation of simple sections and axonometric projection. Theme of extracurricular self-study: The study of the rules and methods of projection. Types of sections: simple and complex. Types of surface treatment and its designation in the drawings. Local and additional types. Making complex drawing of training model. Dimensioning.

Types of couplings. Detachable couplings. Threaded couplings. Types of threads and their parameters, application. Couplings with the help of bolts, pins, screws. Image and marking of thread in the drawings. Non-detachable couplings. Welded, adhesive, riveted connections. Types of welds. Parameters and marking welded joints in the drawing. Exercises for drawing welded joints. Performing a drawing of threaded coupling with bolt. Performing assembly drawing of the welded joint.

Theme of extracurricular self-study: Study of different types of connections and their images in the drawings. Final formatting of assembly drawing.

Elements of technical drawing. Sketch and technical drawing. The rules and the order of implementation: choice of the main view, the preparation of a sheet, the layout of the image, dimensioning and putting symbols. Performance of technical drawing of training model

Theme of extracurricular self-study: Final formatting of technical drawing

Section 3. Special part. Drawing and reading of electrical schemes. Electrical

elements and schemes. Symbols of elements of electrical schemes in the drawing. Types and purposes of electric schemes. The use and reading of electrical schemes. Drawing elements of the electrical schemes in the drawings. Dimensions and terms of elements according to GOST 2.728-14, GOST 2.755-87, GOST 2.756-76. The form of the list of electrical scheme elements in the drawing. Image and marking of electrical scheme elements.

Theme of extracurricular self-study: Insight into the essential typical schemes for heating and lighting of premises and facilities of the aggregates and mechanisms. Reading electrical schemes and explanation of scheme elements markings.

Imaging essential electrical schemes in the drawing. The procedure and rules for the implementation of electrical schemes in the drawing. Reading essential electrical schemes. Drawing a wiring diagram of the facility (heating, lighting, ventilation, feed preparation, etc.)

Theme of extracurricular self-study of the students: Drawing simple wiring diagrams. Searching materials on drawing of electrical schemes of the various units (amplifiers, electric motors, transformers, etc.)

Section 4. Computer graphics. System of computer-assisted design. Purpose and types of graphical software. Rules and order of work with graphical package "Compass". Object snap. Image management. Construction of simple objects. Elements of drawings and schemes.

Theme of extracurricular self-study of the students: Performing exercises for the mastering of a graphical package "Compass". International standards of execution of documentation. Graphical packages "ArchiCAD", "AutoCAD", etc.

Implementation of electrical elements and schemes with the help of graphical packages. Applying hatching. Offset and connecting lines. Dimensioning and marking. Editing objects. Work with text. Frame and title block. Making technical documentation. Specification. Printing drawing - file. Drawing a wiring diagram on the specialty.

Theme of extracurricular self-study of the students: Making a wiring diagram. Searching essential electric schemes in the Internet. Reading electrical schemes. Drawing of schemes of electric actuators, electrical equipment and power supply system using the software. Perform sections, cross sections in the drawings.

Learning Outcomes	Assessment criteria
upon successful completion of this module the student:	
LO1 Simulate electrical schemes using software, is able to design drawings	has to: 1.1 be able to organize the workplace; 1.2 be able to work with reference books and catalogs; 1.3 own professional vocabulary; 1.4 carry out works under the supervision of specialists of higher qualification; 1.5 understand the nature and the social importance of the future profession, show a steady interest to it; 1. 6 be able to work in a team, communicate effectively with colleagues, management, customers; 1.7 apply the basic regulatory requirements according to Electrical installation code, Fire safety rules, Safety rules; 1.8 have electrical circuits reading skills;

	1.9 use ICT to improve the professional activity; 1.10 read assembly drawings and electrical schemes; 1.11 use a structure and purpose of unified system of engineering drawings /USED/; 1.12 perform graphical design of drawings, technical drawing, using standards in the preparation of drawings and sketches of details; 1.13 use computer methods for collecting, storing and processing information; 1.14 use information and communication technologies to improve the professional activity; 1.15 plot different lines in compliance with the standard; 1.16 write inscriptions in the drawings in a standard font; 1.17 determine the scale of the drawing, carry out drawings of details in a given scale; 1.18 carry out various types of conjugations and irregular-curves; 1.19 apply dimensions in drawing of details of a simple form; 1.20 carry out drawing of schemes of electric actuators, electrical equipment and power supply system using the software; 1.21 read, draw and design electrical schemes according to GOST; 1.22 carry out drawing of essential schemes of the mechanical part of electric drives and power supply system; 1.23 be able to draw schemes using graphical package "ArchiCAD", "AutoCAD", etc.; 1.24 be able to make complex drawings of training model with the implementation of simple sections and axonometric projection; 1.25 be able to make a final formatting of assembly drawing; 1.26 when drawing the schemes, use dimensions and terms of elements in accordance with GOST 2.728-14, GOST 2.755-87, GOST 2.756-76.
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BGPM.02 Analysis of electrical system, electronic equipment and control over their functions

Purpose: To give students an idea of electrical circuits and their constituent elements, the basic methods of analysis and calculation of these circuits in static and dynamic modes, i.e., in creating a scientific basis for further study of various special electrical modules.

Objectives: Learning theories of physical phenomena underlying the establishment and functioning of various electrical devices, as well as transfer of practical skills of using methods of analysis and calculation of electrical circuits for a wide range of tasks. To transfer skills of practical determination of physical and mechanical properties of materials and impact pointed at them.

Introduction into module: as a result of study the student should know the basic methods of analysis and calculation of established processes in linear and non-linear circuits with lumped parameters, in linear circuits of non-sinusoidal current, in linear circuits with distributed parameters, the basic methods of analysis and calculation of transient processes in these circuits and be able to use them in practice.

Content of the module: Section 1. Introduction. Initial data on the electric field. The electrical circuit and electrical energy, its properties and use. Main characteristics of the electric field. Strength, electric potential, electric voltage. Conductivity.

Laboratory work № 1 Rules for assembling electrical circuits. Safety rules.

Laboratory work № 2 Experimental verification of Ohm's law.

Laboratory work № 3 Study of modes of electrical circuit and its components.

Laboratory work № 4 Determination of currents using Kirchhoff's laws.

Ionic and semiconductor devices. Integrated circuits. Power supply sources and converter devices. Elements of microprocessor technology. Amplifiers.

Section 2. Conducting materials. Characteristic properties of conductors and semiconductors and their dependence on external conditions. Classification of conducting materials. The main characteristics of conducting materials. Electrical conductivity and resistivity of the conductors and semiconductors. Factors affecting the value of resistivity.

Conducting materials with high strength. Types of conducting materials with a high conductivity. Properties of superconductors and cryo conductors. High-temperature superconductors. Cryo conductors.

Theme of extracurricular self-study: Write a report to the topic "Using the precious metals in the electric power industry".

Section 3 Dielectric materials. Dielectrics and insulating materials. Dielectric materials. Insulating materials.

The properties of dielectric and insulating materials.

Electrical properties of dielectrics and insulating materials. The physical nature of the electrical conductivity of dielectrics. The electrical conductivity of dielectric and insulating materials. Dielectric losses.

Dielectric strength.

Theme of extracurricular self-study: Write a report to the topic "The methods of determination of electrical properties of insulating materials".

Laboratory work № 5. «Determination of resistivity of conducting materials».

Section 4 Non-linear electric DC circuits. The concept of static and dynamic resistance of the nonlinear element.

AC electrical circuits. Elements and parameters of the AC electrical circuits. Calculation of AC electrical circuits using phasor diagrams. Resonance in electrical circuits. The symbolic method for calculating the electrical circuits. Three-phase symmetric and non-symmetric circuits. Transient phenomena in electrical circuits.

Laboratory work № 6 The study of parameters of inductive coils.

Laboratory work № 7 The study of electrical circuits of AC at sequential connection of the active and inductive resistances.

Laboratory work № 8 Determination of power factor by ampere-voltmeter and power meter.

Laboratory work №9 Power measurement in AC circuits (single-phase and three-phase).

Laboratory work № 10 The study of the electrical circuit for phase shift 90° between the current and the voltage

Laboratory work №11 The study of three-phase circuit when connecting receiver by star and delta

Section 5 Measuring instruments. Analogue electrical measuring instruments.

Ionic devices. Configuration, principle of operation, the volt-ampere characteristics and parameters. Devices to display the information. Semiconductors. Converters of current and voltage. Shunts and additional resistance. Recording devices. Integrated circuits.

Laboratory work № 12 The study of triode.

Laboratory work № 13 The study of volt-ampere characteristics of the transistor and defining the h-parameters.

The study of volt-ampere characteristics of the four-layer switch and three-terminal thyristor. Integrated circuits, features of hybrid and semiconductor integrated circuits.

Laboratory work №14 Calculation of shunts and additional resistance

Section 6 Power supply and converter devices. Rectifiers. Mitkevich's diagram and Larionov's diagram. Anti-aliasing filters. Stabilizers of voltage and currents. Controlled rectifiers. Inverters and converters.

Laboratory work № 15 Powerful and low-power single-phase and three-phase rectifier.

Laboratory work №16 Calculation of the rectifier.

Section 7 Amplifiers, scope of use. Cascades of amplifier. Power amplifiers. Multistage amplifiers. Amplifiers of DC. Operational amplifiers.

Laboratory work № 17 The study of work of a low frequency amplifier (LFA)

Laboratory work №18 Calculation of cascade amplifier

Learning Outcomes	Assessment criteria
Upon successful completion of this module the student:	
LO 02 Analyze electrical systems, electronic equipment and control their functions, is able to measure the electrical values, to collect electrical and electronic circuits	<p>Has to:</p> <ul style="list-style-type: none"> 2.1 apply the basic regulatory requirements according to Electrical installation code, Fire safety rules, Safety rules; 2.2 own professional vocabulary; 2.3 be able to organize the workplace; 2.4 carry out works under the supervision of specialists of higher qualification; 2.5 understand the nature and the social importance of the future profession, show a steady interest to it; 2.6 be able to work in a team, communicate effectively with colleagues, management, customers; 2.7 use information and communication technologies for the acquisition of knowledge; 2.8 be able to work with wiring and plumbing tools; 2.9 use shunts and additional resistance to extend the measuring limits of the voltmeter and ammeter; 2.10 identify the purpose of electrical measuring instruments; 2.11 read the scale of electrical measuring appliances; 2.12 be able to use electrical measuring instruments; 2.13 assemble electric circuits of direct and alternating current; 2.14 explain the physical nature and the methods for calculating the resistance, conductivity; 2.15 use electrical engineering laws, binding parameters of the electrical circuit; 2.16 perform calculations of electric circuits of direct and alternating

	<p>current; 3.10 explain the purpose of nonlinear circuits of direct and alternating current;</p> <p>2.17 explain the concepts and calculation methods of electrical circuits of non-sinusoidal current;;</p> <p>2.12 explain the concepts and calculation methods of transients in electrical circuits;</p> <p>2.18 define electrical circuits with distributed parameters.</p> <p>2.19 define electrovacuum and ionic devices; semiconductors: diodes, transistors, thyristors; integrated circuits; amplifiers;</p> <p>2.20 explain the purpose of power supply sources: rectifiers, smoothing filters, multipliers of voltage, stabilizers, inverters and frequency converters; generators of linear vibrations;</p> <p>2.21 explain the purpose of the elements of microprocessor technology and communication technology;</p> <p>2.22 perform calculations on the choice of the amplifier stage;</p> <p>2.23 read and draw simple electronic circuits based on pulsed devices, diodes, transistors and thyristors;</p> <p>2.24 use electronic measuring instruments, analog-to-digital electronic multifunction multimeters, electronic oscilloscope;</p> <p>2.25 apply the safety regulations when using modern technological accounting means of electric energy;</p> <p>2.26 evaluate the quality of measurement by different methods;</p> <p>2.27 use formula values for calculations of real current, voltage values, power in the circuits;</p> <p>2.28 use the knowledge of the formulas in assembling and calculation of circuits;</p> <p>2.29 use knowledge in the study of automation;</p> <p>2.30 determine the parameters of the electrical circuit;</p> <p>2.31 calculate the shunt resistance and additional resistance;</p> <p>2.32 select solders and fluxes;</p> <p>2.33 select insulating materials;</p> <p>2.34 classify conducting materials;</p> <p>2.35 identify brands of wires and cables;</p> <p>2.36 identify brands of steels and cast iron, non-ferrous metals and alloys;</p> <p>2.37 determine the electric strength of insulating materials;</p> <p>2.38 measure the resistivity of the dielectric;</p> <p>2.39 assemble electric circuits;</p> <p>2.40 perform phasing of wire;</p> <p>2.41 determine the parameters of electrical quantities and lead time of transients</p> <p>2.42 explain the physical nature and the methods for calculating the resistance, conductivity;</p> <p>2.43 be able to make decisions independently and efficiently in the educational and professional activity;</p> <p>2.44 be able to carry out the organization of the provision of first aid to victims;</p> <p>2.45 observe general fire safety requirements in planning facilities of industrial enterprises and electrical installations;</p> <p>2.46 observe the fire safety requirements when operating electrical installations and during welding works;</p> <p>2.47 to comply with fire safety in repair shops, maintenance centers, fuel, combustible and flammable materials stores;</p> <p>2.48 use in the professional activity terms and definitions adopted in fire safety;</p> <p>2.49 implement security measures when working with electrical installations of special purpose, safety measures when working in the laboratories of industrial enterprises;</p> <p>2.50 be able to use the means of protection against electric shock.</p>
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BGPM.03 Diagnostics of electrical machines and apparatus

Purpose: to understand the physical processes and determine the actual technical condition of the equipment for the organization of its proper operation, maintenance and repair, as well as identifying possible problems at an early stage of their development.

Objective: learning the device, operating properties of electric machines and transformers, scope of their use.

Content of the module:

Section 1. Transformers. Purpose and structure of transformer, its functions in automatic systems. The principle of operation of the transformer. Equivalent circuit for the transformer replacement. Experiments of idle run and short circuit of transformers. Calculation of parameters of replacement circuit according to passport data. Parallel operation of transformers. Features of three-phase transformers. Understanding about the connection groups of three-phase transformers. Autotransformers. Voltage and current measuring transformers. Technology of measurement of grounding devices and resistance.

Laboratory work №1 The study of two-winding power transformer by method of idle run and short circuit.

Laboratory work №2 Experimental determination of the groups of connection of three-phase two-winding transformer.

Section 2. Electric machines. The theory of generalized electric machine. The equation of the generalized electric machine. The main types of AC machines and their comparative analysis. Electromotive force of AC windings. The magnetic field of the polyphase winding. Asynchronous and synchronous speed. Causes of malfunctions and failures of electrical equipment associated with electrotechnical materials.

Section 3. Asynchronous machines. The types of asynchronous machines. Design of commutatorless asynchronous machines. The principle of operation of the asynchronous machine. Sliding motion. Operation mode. Bringing the asynchronous machine to the diagram of the generalized electrical machine. Energy diagram of operation of the asynchronous motor. Mechanical and rheostat characteristics. Stable operation. Control of the operating speed and motor reversing. Launching the asynchronous motor. Braking modes. The principle of operation of the single-phase asynchronous motor. Features of single-phase asynchronous motors (motor with starting winding, condenser motor, motor with high rotor winding resistance, motor with hollow rotor).

Laboratory work № 3 The study of a three-phase asynchronous motor with squirrel-cage rotor.

Laboratory work №4 The study of a three-phase asynchronous motor by method of idle run and short circuit.

Laboratory work №5 Defining the beginning and the end of the asynchronous motor stator windings.

Laboratory work № 6 The study of the ways of launching three-phase asynchronous motors.

Section 4. Synchronous machines. Design of synchronous machines: types, principle of operation, modes of operation. The operating principle of a three-phase synchronous generator. The principle of operation of the synchronous motor.

Simplified vector diagram of the phase of synchronous motor. Angle and U- shaped characteristics. Stable operation. Asynchronous starting of synchronous motors. Advantages and disadvantages.

Direct current electric machines. DC machines. Types. The operating principle of the DC generator. Design and principle of operation of commutator motor.

Laboratory work № 7 The study of three-phase synchronous generator and motor.

Laboratory work №8 The study of three-phase synchronous generator, concurrently operating with the network.

Section 5. The operating principle and design of DC commutator machines. Armature windings of DC machines. The principle of the implementation of the armature windings. Types of windings: simple, lap, simple wave, complex lap, complex wave and combined. The DC commutator motors of parallel, series and mixed excitation - connection circuits, the operating principle, the main characteristics, the scope of use.

The DC commutator motor of series excitation, universal commutator motor - design features, characteristics, scope of use. Adjustment properties of commutator motors. The principle of operation of commutatorless AC machines. The principle of implementation and basic types of stator windings. The principle of implementation of stator winding (armature); the concept of a coil (section), the pole division, slop pitches. EMF of winding conductor. Schedule of distribution of magnetic induction in the air gap of the machine. Compliance with safety regulations during the operation of existing plants. Machines of special purpose. Safety precautions when working with electrical installations of special purpose.

Laboratory work №9 The study of the generator and the DC motor of parallel excitation

Section 6. Classification of generators. Main parameters. Generators of linear oscillations Pulse signal parameters. The operating principle of the simplest pulse signal shapers. Principles of operation of multivibrators and univibrators. The principle of operation of the circuits. Diagrams explaining the principle of operation of the circuits. Purpose and scope of logic elements and adders. Scheme of implementation of the logical elements.

Logical elements. Purpose and scope of logic elements and adders. Scheme of implementation of the logical elements.

Laboratory work №10 Transistor logic elements.

Learning Outcomes	Assessment criteria
Upon successful completion of the module “Diagnostics of electrical machines and apparatus” the student:	
LO 03 to be able to perform diagnostics of electrical machines and apparatuses	Has to: 3.1 own professional vocabulary; 3.2 be able to organize the workplace; 3.3 carry out works under the supervision of specialists of higher qualification; 3.4 understand the nature and the social importance of the future profession, show a steady interest to it; 3. 5 be able to work in a team, communicate effectively with colleagues, management, customers;

	<p>3.6 apply the basic regulatory requirements according to Electrical installation code, Fire safety rules, Safety rules;</p> <p>3.7 have electrical circuits reading skills;</p> <p>3.8 use information and communication technologies to improve the professional activity.</p> <p>3.9 determine the electrical materials, magnetic materials; conducting materials; wires, tires, cables; semiconductor materials by the properties and scope of use;</p> <p>3.10 explain the purpose of insulating materials, gaseous dielectrics, polarization materials, electrical insulating materials.</p> <p>3.11. explain the structure and principle of operation of DC machine; wiring of DC generators; DC motor; principle of operation of start-up engine; performance; construction and principle of operation of the transformers; modes of operation;</p> <p>3.12. identify groups and connection schemes of transformers; autotransformers, three-winding and special transformers;</p> <p>3.13. explain the structure and function of synchronous generators; principle of operation and structure of synchronous and asynchronous motors.</p> <p>3.14 distinguish logic elements;</p> <p>3.15 read and make simple electronic circuits based on simple logic elements;</p> <p>3.16 analyze time schedules and diagrams, instrumentation and control equipment;</p> <p>3.17 work with catalogs and reference books;</p> <p>3.18 be able to work with circuits current and voltage transformers, auto-transformers</p> <p>3.19 apply the laws of electrical engineering;</p> <p>3.20 calculate and construct a detailed diagram of the windings;</p> <p>3.21 calculate the magnetic circuit of the machine;</p> <p>3.22 eliminate arcing in electrical machines;</p> <p>3.23 collect motor circuits and take characteristics;</p> <p>3.24 solve problems on the calculation of parameters and the implementation of the detailed diagrams of the winding of the armature; calculation of magnetic DC circuit; calculation of EMF and MMF of the windings, electromagnetic torque and operating speed of commutator cars; calculation of losses and efficiency; calculation of electromagnetic torque and power; calculation and development of characteristics of the machines of direct and alternating current;</p> <p>3.25 perform assembly of switching circuit of DC machines, asynchronous and synchronous motors;</p> <p>3.26 select instrumentation and ballasts;</p> <p>3.27 solve problems on calculation of the parameters and characteristics of transformers and on load distribution between parallel-connected transformers;</p> <p>3.28 measure, be able to work with wiring and plumbing tools;</p> <p>3.29 apply resistance and grounding devices measurement technology;</p> <p>3.30 select measuring transformers;</p> <p>3.31 identify the causes of malfunctions and failures of electrical equipment associated with electrical engineering materials;</p> <p>3.32 understand the issues of depending the quality of repair and installation works on the choice of electrical engineering material;</p> <p>3.33 select a brand of a winding wire;</p> <p>3.34 perform selection of an electrically insulating material for electrical machines of direct and alternating currents according to heat resistance and electric strength;</p>
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	3.35 measure the frequency phase, phases shift by devices; 3.36 measure resistance of capacitance, inductance by laboratory instruments; 3.37 measure the level of insulation, the insulation quality; 3.38 perform testing of insulation by voltage increase; 3.39 measure the insulation resistance; 3.40 perform temporary and speed rating of circuit breakers; 3.41 test the power cable; 3.42 execute the test report; 3.43 measure the dielectric loss tangent; 3.44 to measure the resistance of the windings of DC electrical machines; 3.45 determine the polarity of the windings; 3.46 testing insulation of windings; 3.47 draw schemes of hooking up the devices into the electrical network and perform their selection; 3.48 determine structural elements of transformers measuring current and voltage; 3.49 perform operations with switching devices; 3.50 be able to decipher the brand of motors and transformers; 3.51 carry out organizational arrangements for health and safety during repair works in electrical installations; 3.52 use protection devices against harmful industrial factors; 3.53 apply safety rules during the installation of electrical machinery, electrical equipment and electrical wiring; 3.54 implement security measures during the operation of portable power tools and portable electrical installations; 3.55 implement security measures when working on electrical installations of special purpose; 3.56 comply with the general rules of electrical safety during the operation of active electrical installations; 3.57 observe safety requirements during electrical equipment repair; 3.58 observe safety rules during mechanical and machine tool works, the requirements of occupational safety during welding and soldering; 3.59 perform the safe use of manual electrified tools and portable lamps; 3.60 apply a resistance normalization of grounding devices; 3.61 be able to use electrical safety devices used in electrical installations; 3.62 remember the order of use, purpose and content of the electrical safety devices.
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PM 00. Professional modules

PM.01 Serving agricultural electrical installations and aggregates

Purpose: To form a system of theoretical and practical knowledge in the field of electric actuator and electrical equipment capable of solving the practical problems of agricultural production effectively, as well as contributing to the further development of the individual.

Objectives: Study the scientific and technological achievements in the field of modern electric actuators and electrical equipment in areas of agricultural production; learn to rate the electric actuators and to select, operate electrical equipment for machines and installations of agricultural production;

Content of the module:

Fundamentals of the electric actuator. Mechanical characteristics of electric

actuators. Transients in electric actuators. Calculation of power in electric actuators. Energy of electric actuators. Equipment for control and protection of electric motors. Automatic control of electric actuators. Electric actuators of machines, aggregates and in-line machines. Features of the operation of electric actuators in the conditions of agricultural production. Electric actuator of ventilation systems. Electric actuator of feeders and transport facilities. Electric actuator of milking machines and milk primary processing machines. Electric actuator of shearing machines. Electric actuator of machines and units of grain cleaning points and aggregates. Electric actuator of metal and woodworking machines and stands for running engines. Technical - economic basis for the application of electric energy of thermal and heating processes in agricultural production. The method and apparatus for converting electrical energy into thermal. Electric water heaters Electric heating installations for the creation and regulation of microclimate. Electric heating installations for thermal treatment and drying of agricultural products and feeds.

Learning Outcomes	Criteria for evaluation
Upon successful completion of this module the student:	
LO1 Operate electrical and automation equipment, knows the basic concepts of energy systems; requirements for electrical networks, scope of use of various types of transmission lines;	<p>Has to:</p> <ol style="list-style-type: none"> 1.1. be able to organize the workplace; 1.2. own professional vocabulary; 1.3 carry out works under the supervision of specialists of higher qualification; 1.4 know computer methods for data collection, storage and processing; 1.5 be able to work in a team, communicate effectively with colleagues, management, customers; 1.6. apply the basic regulatory requirements according to Electrical installation code, Fire safety rules, Safety rules; 1.7. be able to work with wiring and plumbing tools; 1.8 have electrical circuits reading skills; 1.9 use information and communication technologies to improve the professional activity; 1.10 be able to work with reference books and catalogs; 1.11 explain the purpose of electrical substations, power transformers, step-down electrical substations with voltage up to 110 kV; high-voltage equipment of substations, short-circuits, the distribution of group lighting boards; 1.12 distinguish supports, wires and structural elements of overhead power lines; 1.13 perform mechanical rate of overhead power lines; 1.14 perform selection of cable transmission lines equipment; analysis of simple closed networks, section analysis of supply and group network by the permissible current and voltage failure; 1.15 perform selection of wire brand and cabling method; use the classification of equipment by its purpose, the principle of operation, characteristics of configuration, selection criteria. 1.16 apply in practice the rules for safe operation, labor protection, legal and regulatory framework; 1.17 identify occupational injury and disease; 1.18 determine the factors affecting the working conditions; 1.19 be able to perform the analysis of the cross section of supply and group network by allowable current and voltage loss; 1.20 use information about power consumers;

	<p>1.21 perform the analysis of simple closed networks;</p> <p>1.22 estimate and select an electric actuator, control, protection, switching devices; draw schemes, read schemes;</p> <p>1.23 estimate pipelines;</p> <p>4.24 select an electric motor, protection and switching devices, automation components; read schemes;</p> <p>1.25 calculate the power of the main actuator and auxiliary electric actuators;</p> <p>1.26 select the type and capacity of the motor, check the EA;</p> <p>1.27 design simple control schemes, analyze brake modes;</p> <p>1.28 choose devices and control system, contactless EA control circuits;</p> <p>1.29 select electric machines and equipment according to category B or P according to Electrical installation code;</p> <p>1.30 select the type and power of EA;</p> <p>1.31 select switching, protective equipment;</p> <p>1.32 choose for each mechanism type and power of electric motor;</p> <p>1.33 constitute a control scheme;</p> <p>1.34 select electrical equipment;</p> <p>1.35 select the type and power of EA;</p> <p>1.36 select switching, protective equipment;</p> <p>1.37 select an electric actuator and electrical equipment according to the operation and category of placement; control schemes, automation system;</p> <p>1.38 select switching, protective equipment;</p> <p>1.39 perform necessary calculations, analyses;</p> <p>1.40 use the obtained knowledge to solve practical problems on the design, installation, adjustment, testing and commissioning of the modern electric actuator, proper operation and maintenance of the electric actuator, the use of modern information technologies and software packages for experimental studies on the model of the electric actuator in different static and transient modes;</p> <p>1.41 execute results of the calculation and analysis in accordance with USED.</p> <p>1.42 diagnose damage to electrical equipment in industrial enterprises, analyze the causes of failures of an electric equipment of electric power systems;</p> <p>1.43 perform calculation of the power and selection of the electric actuator for different kinds of working machines;</p> <p>1.44 set up equations of motion in the motor and motor brake modes of electric motor;</p> <p>1.45 draw a kinematic scheme of EA;</p> <p>1.46 carry out the maintenance and operation of electrical machines and transformers, substations and distribution networks;</p> <p>1.47 read lighting control schemes;</p> <p>1.48 check and adjust the security settings by primary current at all kinds;</p> <p>1.49 perform connections of secondary current circuits;</p> <p>1.50 check and configure the protection against single-phase earth faults;</p> <p>1.51 check and configure the protection against undervoltage;</p> <p>1.52 kinematic schemes of inspected devices;</p> <p>1.53 testing standards of AC circuit breakers;</p> <p>1.54 testing standards of DC circuit breakers;</p> <p>1.55 identify the causes of malfunction of the switch;</p> <p>1.56 adjust the kinematics of the switch;</p> <p>1.57 take time-current characteristic of the switch;</p>
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	1.58 apply safety rules during the works on repair of electrical switchgears; 1.59 perform organizational arrangements for health and safety during electrical works, safety measures when installing switchgear and conductors; 1.60 be able to carry out the organization of occupational health, safety, industrial hygiene and fire protection; 1.61 comply with the terms of electrical safety in networks with voltage up to 1000 V; 1.62 assess the insulation of the wires and the mode of operation of the neutral point of the network as electrical safety factors; 1.63 apply insulation of conductive parts; 1.64 use as intended portable lights and automatic voltage signaling devices; 1.65 be able to apply the protective earth connection and disconnection; 1.66 relieve the victim from the action of an electric current; 1.67 provide first aid to the victim of the current action; 1.68 use individual and collective means of protection against electric shock.
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PM.02 Maintenance and provision of electricity

Purpose: formation of a system of knowledge and practical skills needed to solve problems related to electricity in rural settlements, buildings, businesses, farms and country farmsteads.

Objectives: Control of the quality of electricity. Reliability of power supply. Requirements for the reliability of consumers' power supply of first, second and third categories.

Content of the module: General information about the production, transmission and distribution of electric energy. Wires, cables and their selection by the permissible heating. The structure of internal wires and cable lines. Graphs of loads and energy losses in the electrical networks. Acceptable voltage losses in the network. Calculation of open networks in a uniform and non-uniform load. Calculation of closed networks. The equipment and the conductor of the switchgear. Control - measuring instruments and measuring transformers. Rural transformer substations and reserve power stations. Calculation of short circuit currents and earth fault currents. Relay protection. Automation of power plants and substations. Protection against atmospheric overvoltage. The garmesh and garmesh devices. Occupational safety in the operation, maintenance and repair of electrical equipment of manufacturing enterprises. Protection against electric shock.

Practical work №1. Calculation of the electrical load by method of demand factor

Practical work № 2. Calculation of the electrical load by method of capacity factor

Practical work №3. Building a daily schedule of electric load according to duration

Practical work №4. Calculate electrical loads of industrial enterprises.

Practical work №5. Selecting protective switchgear and conducting products, taking into account the choice of fuse protection devices.

Practical work №6. Drawing up load graphs for various industries.

Practical work № 7. Determination of active, reactive, full power by the shops to select the power transformers at substations shops.

Practical work № 8. Determination of power losses in separate elements of the power supply system, measures to reduce them.

Practical work №9 Selecting discharge resistance.

Practical work №10 Calculation of power of compensating device with a choice of the type and place of installation of capacitor banks

Practical work № 11 Solving the tasks on the given terms to determine the number and power of transformers at the substation

Practical work № 12 Calculation of short circuit currents in power supply system (4h)

Practical work № 13 Selection and verification of the busbars of conducting products

Practical work № 14 Solving tasks on short circuit currents operation and selection of high-voltage devices

Practical work № 15 Selection and verification of current-limiting devices

Practical work №16 To study the technique of first aid to the victim from the effects of electric current.

Learning Outcomes	Assessment criteria
Upon successful completion of this module the student:	
LO 02 understands the systems of power supply of agricultural enterprises, intrashop power supply of enterprises, the essence of power, lighting and automation equipment	<p>Has to:</p> <ul style="list-style-type: none"> 2.1. be able to organize the workplace; 2.2 own professional vocabulary; 2.3 carry out works under the supervision of specialists of higher qualification; 2.4 know computer methods for data collection, storage and processing; 2.5 be able to work in a team, communicate effectively with colleagues, management, customers; 2.6 apply the basic regulatory requirements according to Electrical installation code, Fire safety rules, and Safety rules. 2.7. be able to work with wiring and plumbing tools; 2.8 have electrical circuits reading skills; 2.9 use information and communication technologies to improve the professional activity; 2.10 be able to work with reference books and catalogs; 2.11 explain the features of the system of power supply of agricultural enterprises; intrashop power supply of enterprises; the main step-down substations (MSS); 2.12 distinguish power and lightening equipment; 2.13 classify electric receivers according to the degree of security of electricity supply and modes of operation; 2.14 determine the protection of electrical networks in installations up to 1000 V; 2.15 read power supply circuits with voltage up to 1000 V; 2.16 apply electric receivers classification according to the degree of security of electricity supply and modes of operation; 2.17 evaluate the protection of electrical networks in installations up to 1000 V, power supply of agricultural enterprises; 2.18 be able to distinguish power supply circuits with voltage up to 1000 V; 2.19 understand the purpose of the main step-down substations (MSS); protection of electrical networks in installations up to 1000 V; 2.20 calculate the power and select electrical motors for various operating machines;

	<p>2.21 select necessary equipment depending on the technical requirements;</p> <p>2.22 perform the calculation of electrical loads on the substation sites (DP, DPA, MCC);</p> <p>2.23 carry out calculation of short circuit currents;</p> <p>2.24 verify equipment for thermal and dynamic stability according to cartograms of electrical loads;</p> <p>2.25 select schemes of internal and external power supply of plants and concerns;</p> <p>2.26 choose the power transformer according to the categorization and allowed overload;</p> <p>2.27 calculate grounding devices and their performance;</p> <p>2.28 solve issues on designing switchgears;</p> <p>2.29 draw up relay protection circuit and select relay;</p> <p>2.30 draw up and read control, accounting and alarm circuits;</p> <p>2.31 read the circuits of automatic transfer switch (ATS), AR;</p> <p>2.32 select protection and electrics for the power supply networks of industrial enterprises and civil buildings;</p> <p>2.33 draw up and read control, accounting and alarm circuits;</p> <p>2.34 use modern technical means of electric energy accounting;</p> <p>2.35 select electric energy accounting system for the enterprise;</p> <p>2.36 carry out the installation of lighting wiring, installation of grounding of electrical equipment;</p> <p>2.37 perform resistance measurement of electrical circuits, windings of electrical machines and apparatus; verify insulation of electrical equipment;</p> <p>2.38 draw up electric circuits and perform the installation of the lighting wiring, installation of grounding of electrical equipment;</p> <p>2.39 measure the resistance of electrical circuits, windings of electrical machines and apparatus;</p> <p>2.40 calculate grounding devices and their performance;</p> <p>2.41 test insulation of various types of electrical equipment;</p> <p>2.42 determine the currents of protective devices installations (filaments, releasers of circuit breakers, relays);</p> <p>2.43 select power transformers at substations;</p> <p>2.44 draw cartogram of loads and perform selection of the number and location of substations;</p> <p>2.45 choose the transformer capacity depending on the operating mode;</p> <p>2.46 choose the section and construction of conductors in a variety of electric networks;</p> <p>2.47 select high-voltage equipment for electric power supply systems;</p> <p>2.48 apply the "Regulations on the investigation and recording industrial accidents";</p> <p>2.49 apply the "Regulations on the investigation of non-production injury";</p> <p>2.50 own methods of organization of inspection and safety assessment of production processes in the industry;</p> <p>2.51 apply normative-technical, design, organizational, administrative and other documentation for the thoroughness of safety requirements and their compliance with applicable laws, rules and regulations;</p> <p>2.52 own fire-fighting techniques in different conditions;</p> <p>2.53 determine active and reactive resistance of wire and cable;</p> <p>2.54 determine active and reactive conductivity of power lines, charging currents and power of lines;</p> <p>2.55 determine active and inductive resistance and conductivity of two- and three-winding transformers;</p>
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	<p>2.56 determine expenses for the electrical network and for operation and maintenance of network facilities;</p> <p>2.57 choose the sections of the wires by the method of economic intervals;</p> <p>2.58 choose the sections of wires and cable cores with taking into account the construction of electrical networks, type of protection and conditions of laying electric lines;</p> <p>2.59 carry out calculations of equivalent circuits of PTL of local electrical networks, equivalent circuits of transformers,</p> <p>2.60 perform calculations of power and electric energy losses in electrical lines by various methods;</p> <p>2.61 carry out selection of wire and cable cores according to economic current density by method of economic intervals;</p> <p>2.62 carry out selection of fuse-links and circuit breakers installations on the conditions of permissible heating;</p> <p>2.63 select the sections of wires and cable cores on the permissible heating;</p> <p>2.64 determine the voltage losses in the electrical lines of three-phase current by several consumers;</p> <p>2.65 determine the highest voltage loss;</p> <p>2.66 identify points of the flow division;</p> <p>2.67 perform the calculation of voltage losses in two-wire lines, in lines of three-phase current and the highest voltage losses;</p> <p>2.68 determine the loss of selected sections of wires and cable cores on the permissible voltage loss;</p> <p>2.69 perform the calculation of the closed local power supply network by several energy consumers;</p> <p>2.70 select the operating voltage of the electric network by comparing the options;</p> <p>2.71 determine the reliability of the elements of electrical networks by structural schemes;</p> <p>2.72 backup power supply schemes of the local electric networks;</p> <p>2.73 determine the nominal voltage of the electrical network according to the load and the length of the line;</p> <p>2.74 carry out technical and economic calculations when selecting schemes of networks taking into account the damage caused by interruptions in the power supply and read electrical networks circuits of power lines;</p> <p>2.75 determine the mechanical load on the wire and the maximum allowable voltage in the metal of wires; maximum wire sag;</p> <p>2.76 perform the calculation of wires of AC brand on the mechanical load</p> <p>2.77 choose the transformer capacity depending on the operating mode;</p> <p>2.78 choose the section and construction of conductors in various electrical networks and insulators for their fastening;</p>
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Higher level

151802 2 - Electrical fitter

BGPM.00 General professional modules

BGPM.01 Simulate electrical circuits using software

Purpose: development of knowledge and skills needed for students to perform and read technical drawings

Objective: development of skills for drawing sketches of parts, for issuing design and technical documentation using software.

Introduction into module: Module «Simulate electrical circuits using software»

is a base general professional module and is represented in the structure of the basic professional educational program of specialty 110810 Electrification and automation of agriculture in the cycle of general professional disciplines (GP.01).

For the capture of the module the students use their knowledge, skills, formed in the course of studying the subject “Drawing” at school.

Mastering the module is a necessary foundation for further study of professional modules.

Content of the module:

Section 1. Graphical design of drawings. Drawing as a document of the Unified system of engineering drawings. Exercises for drawing lines. Information about the standard fonts. Parameters of letters and numbers. Rules for letters, individual words and sentences image. Exercises for the image of letters and numbers. Drawing main lines used in the drawings.

The subject of individual work: The final graphical implementation of works. Forms of the title block in the drawings. Drawing numbers and letters in different fonts.

Geometric constructions in the performance of graphical works. Rules for dimensioning in the drawings: drawing of linear and angular dimensions. Scales. The division of the segments of lines and circles into equal parts. Conjugations of lines used in the parts geometrics. Exercises for the implementation of various conjugations in the drawing. Drawing of parts geometrics through dividing the circle into parts and constructing conjugations and applying of dimensions.

The subject of individual work: Geometric constructions: construction and division of angles. Drawing parts geometrics.

Section 2. Projection drawing.

Drawing up an integrated drawing of training model with the implementation of simple cuts and axonometric projection.

Theme of extracurricular self-study: The study of the rules and methods of projection. Types of sections: simple and complex. Types of surface treatment and its designation in the drawings. Local and additional types. Making complex drawing of training model. Dimensioning.

Types of couplings. Couplings with the help of bolts, pins, screws. Welded, adhesive, riveted couplings. Exercises for drawing welded joints. Performing a drawing of threaded coupling with bolt. Performing assembly drawing of the welded joint.

Theme of extracurricular self-study: Study of different types of connections and their images in the drawings. Final formatting of assembly drawing.

Elements of technical drawing. Sketch and technical drawing. The rules and the order of implementation: choice of the main view, the preparation of a sheet, the layout of the image, dimensioning and putting symbols. Performance of technical drawing of training model.

Theme of extracurricular self-study: Final formatting of technical drawing.

Section 3. Special part. Drawing and reading electrical circuits. Electrical elements and schemes. Symbols of elements of electrical schemes in the drawing. Types and purposes of electric circuits. The use and reading of electrical circuits. Drawing elements of the electrical circuits in the drawings. Dimensions and terms

of elements according to GOST 2.728-14, GOST 2.755-87, GOST 2.756-76. The form of the list of electrical circuit elements in the drawing. Image and marking of electrical circuit elements.

Theme of extracurricular self-study: Insight into the essential typical circuits for heating and lighting of premises and facilities of the units and mechanisms. Reading electrical circuits and explanation of circuits elements markings. Imaging essential electrical circuits in the drawing. The procedure and rules for the implementation of wiring diagrams in the drawing. Reading essential electrical circuits. Drawing a wiring diagram of the facility (heating, lighting, ventilation, feed preparation, etc.)

Theme of extracurricular self-study: Drawing simple wiring diagrams. Searching for materials on drawing up electrical circuits of the various units operation (amplifiers, electric motors, transformers, etc.)

Section 4. graphics. System of computer-assisted design. Purpose and types of graphical software. Rules and order of work with graphical package "Compass". Object snap. Image management. Construction of simple objects.

Elements of drawings and schemes.

Theme of extracurricular self-study: Performing exercises for the mastering a graphical package "Compass".

International standards of execution of documentation. Graphical packages "ArchiCAD", "AutoCAD", etc.

Implementation of electrical elements and circuits with the help of graphical packages. Applying hatching. Offset and connecting lines. Dimensioning and marking. Editing objects. Work with text. Frame and title block. Making technical documentation. Specification. Printing drawing - file. Drawing a wiring diagram on the specialty.

Theme of extracurricular self-study: Making a wiring diagram. Searching for essential electric schemes on the Internet. Reading electrical schemes. Drawing of schemes of electric actuators, electrical equipment and power supply system using the software. Perform sections, cross sections in the drawings.

Learning Outcomes	Assessment criteria
Upon successful completion of this module the student:	
LO1 Is able to simulate electrical circuits using software and to design drawings	<p>Has to:</p> <ul style="list-style-type: none"> 1.1 be able to organize the workplace; 1.2 be able to work with reference books and catalogs; 1.3 own professional vocabulary; 1.4 carry out works under the supervision of specialists of higher qualification; 1.5 understand the nature and the social importance of the future profession, show a steady interest to it; 1.6 be able to work in a team, communicate effectively with colleagues, management, customers; 1.7 apply the basic regulatory requirements according to Electrical installation code, Fire safety rules, Safety rules; 1.8 have electrical circuits reading skills; 1.9 use ICT to improve the professional activity. 1.10 read assembly drawings and electrical schemes; 1.11 use a structure and purpose of unified system of engineering drawings /USED/;

	1.12 perform graphical design of drawings, technical drawing, using standards in the preparation of drawings and sketches of details; 1.13 use computer methods for collecting, storing and processing information; 1.14 use information and communication technologies to improve the professional activity; 1.15 plot different lines in compliance with the standard; 1.16 write inscriptions in the drawings in a standard font; 1.17 determine the scale of the drawing, carry out drawings of details in a given scale; 1.18 carry out various types of conjugations and irregular-curves; 1.19 apply dimensions in drawing of details of a simple form; 1.20 carry out drawing of schemes of electric actuators, electrical equipment and power supply system using the software; 1.21 read, draw and design electrical schemes according to GOST; 1.22 carry out drawing of essential schemes of the mechanical part of electric drives and power supply system; 1.23 be able to draw schemes using graphical package "ArchiCAD", "AutoCAD", etc.; 1.24 perform section and cross sections in the drawings; 1.25 explain the types of cross-sections and their markings 1.26 be able to make complex drawings of training model with the implementation of simple sections and axonometric projection; 1.27 be able to make a final formatting of assembly drawing 1.28 when drawing the schemes, use dimensions and terms of elements in accordance with GOST 2.728-14, GOST 2.755-87, GOST 2.756-76..
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BGPM.02 Analysis of electrical system, electronic equipment and control over their functions

Purpose: To give students an idea of electrical circuits and their constituent elements, the basic methods of analysis and calculation of these circuits in static and dynamic modes, i.e., in creating a scientific basis for further study of various special electrical modules.

Objectives: Learning theories of physical phenomena underlying the establishment and functioning of various electrical devices, as well as transfer of practical skills of using methods of analysis and calculation of electrical circuits for a wide range of tasks. To transfer skills of practical determination of physical and mechanical properties of materials and impact pointed at them.

Introduction into module: As a result of study the student should know the basic methods of analysis and calculation of established processes in linear and non-linear circuits with lumped parameters, in linear circuits of non-sinusoidal current, in linear circuits with distributed parameters, the basic methods of analysis and calculation of transient processes in these circuits and be able to use them in practice.

Content of the module:

Section 1. Introduction. Initial data on the electric field. The electrical circuit and electrical energy, its properties and use. Main characteristics of the electric field. Strength, electric potential, electric voltage. Conductivity.

Laboratory work № 1 Rules for assembling electrical circuits. Safety rules.

Laboratory work № 2 Experimental verification of Ohm's law.

Laboratory work № 3 Study of modes of electrical circuit and its components.

Laboratory work № 4 Determination of currents using Kirchhoff's laws.

Ionic and semiconductor devices. Integrated circuits. Power supply and converter devices. Elements of microprocessor technology. Amplifiers.

Section 2. Semiconducting materials. Characteristic properties of conductors and their dependence on external conditions. Classification of conducting materials. The main characteristics of conducting materials. Electrical conductivity and resistivity of the conductors. Factors affecting the value of resistivity.

Conducting materials with high strength. Types of conducting material with a high conductivity. Properties of superconductors and cryo conductors. High-temperature superconductors. Cryo conductors.

Theme of extracurricular self-study: Write a report to the topic "Using the precious metals in the electric power industry".

Section 3 Dielectric materials. Dielectrics and insulating materials. Dielectric materials. Insulating materials.

The properties of dielectric and insulating materials.

Electrical properties of dielectrics and insulating materials. The physical nature of the electrical conductivity of dielectrics. The electrical conductivity of dielectric and insulating materials. Dielectric losses.

Dielectric strength.

Theme of extracurricular self-study: Write a report to the topic "The methods of determination of electrical properties of insulating materials".

Laboratory work № 5. «Determination of resistivity of conducting materials».

Section 4 Non-linear electric DC circuits.

The concept of static and dynamic resistance of the nonlinear element.

AC electrical circuits. Elements and parameters of the AC electrical circuits. Calculation of AC electrical circuits using phasor diagrams. Resonance in electrical circuits. The symbolic method for calculating the electrical circuits. Three-phase symmetric and non-symmetric circuits. Transient phenomena in electrical circuits.

Laboratory work № 6 The study of parameters of inductive coils.

Laboratory work № 7 The study of electrical circuits of AC at sequential connection of the active and inductive resistances.

Laboratory work № 8 Determination of power factor by ampere-voltmeter and power meter.

Laboratory work №9 Power measurement in AC circuits (single-phase and three-phase).

Laboratory work № 10 The study of the electrical circuit for phase shift 90° between the current and the voltage

Laboratory work №11 The study of three-phase circuit when connecting receiver by star and delta

Section 5. Measuring instruments. Analogue electrical measuring instruments. Ionic devices. Structure, principle of operation, the volt-ampere characteristics and

parameters. Devices to display the information. Semiconductors. Converters of current and voltage. Shunts and additional resistance. Recording devices. Integrated circuits,

Laboratory work № 12 The study of triode.

Laboratory work № 13 The study of volt-ampere characteristics of the transistor and defining the h-parameters.

The study of volt-ampere characteristics of the four-layer switch and three-terminal thyristor. Integrated circuits, features of hybrid and semiconductor integrated circuits.

Laboratory work №14 Calculation of shunts and additional resistance

Section 6. Power supply and converter devices. Rectifiers. Mitkevich's diagram and Larionov's diagram. Anti-aliasing filters. Stabilizers of voltage and currents. Controlled rectifiers. Inverters and converters.

Laboratory work № 15 Powerful and low-power single-phase and three-phase rectifier.

Laboratory work №16 Calculation of the rectifier.

Section 7 Amplifiers, scope of use. Cascades of amplifier. Power amplifiers. Multistage amplifiers. Amplifiers of DC. Operational amplifiers.

Laboratory work № 17 The study of work of a low frequency amplifier (LFA)

Laboratory work №18 Calculation of cascade amplifier

Learning Outcomes	Assessment criteria
Upon successful completion of this module the student:	
LO 02 Is able to measure the electrical values, to collect electrical and electronic circuits	Has to: 2.1 apply the basic regulatory requirements according to Electrical installation code, Fire safety rules, Safety rules; 2.2 own professional vocabulary; 2.3 be able to organize the workplace; 2.4 carry out works under the supervision of specialists of higher qualification; 2.5 understand the nature and the social importance of the future profession, show a steady interest to it; 2.6 be able to work in a team, communicate effectively with colleagues, management, customers; 2.7 use information and communication technologies for the acquisition of knowledge; 2.8 be able to work with wiring and plumbing tools; 2.9 use shunts and additional resistance to extend the measuring limits of the voltmeter and ammeter; 2.10 identify the purpose of electrical measuring instruments; 2.11 read the scale of electrical measuring appliances; 2.12 be able to use electrical measuring instruments; 2.13 assemble electric circuits of direct and alternating current; 2.14 explain the physical nature and the methods for calculating the resistance, conductivity; 2.15 use electrical engineering laws, binding parameters of the electrical circuit; 2.16 perform calculations of electric circuits of direct and alternating current; 3.10 explain the purpose of nonlinear circuits of direct and alternating current;

	<p>2.17 explain the concepts and calculation methods of electrical circuits of non-sinusoidal current;</p> <p>2.18 explain the concepts and calculation methods of transients in electrical circuits;</p> <p>2.19 define electrical circuits with distributed parameters.</p> <p>2.20 define electrovacuum and ionic devices; semiconductors: diodes, transistors, thyristors; integrated circuits; amplifiers;</p> <p>2.21 explain the purpose of power supply sources: rectifiers, smoothing filters, multipliers of voltage, stabilizers, inverters and frequency converters; generators of linear vibrations;</p> <p>2.22 explain the purpose of the elements of microprocessor technology and communication technology;</p> <p>2.23 perform calculations on the choice of the amplifier stage;</p> <p>2.24 read and draw simple electronic circuits based on pulsed devices, diodes, transistors and thyristors;</p> <p>2.25 use electronic measuring instruments, analog-to-digital electronic multifunction multimeters, electronic oscilloscope;</p> <p>2.26 apply the safety regulations when using modern technological accounting means of electric energy;</p> <p>2.27 evaluate the quality of measurement by different methods;</p> <p>2.28 use formula values for calculations of real current, voltage values, power in the circuits;</p> <p>2.29 use the knowledge of the formulas in assembling and calculation of circuits;</p> <p>2.30 use knowledge in the study of automation;</p> <p>2.31 determine the parameters of the electrical circuit;</p> <p>2.32 calculate the shunt resistance and additional resistance;</p> <p>2.33 select solders and fluxes;</p> <p>2.34 select insulating materials;</p> <p>2.35 classify conducting materials;</p> <p>2.36 identify brands of wires and cables;</p> <p>2.37 identify brands of steels and cast iron, non-ferrous metals and alloys;</p> <p>2.38 determine the electric strength of insulating materials;</p> <p>2.39 measure the resistivity of the dielectric;</p> <p>2.40 assemble electric circuits;</p> <p>2.41 perform phasing of wire;</p> <p>2.42 determine the parameters of electrical quantities and lead time of transients</p> <p>2.43 explain the physical nature and the methods for calculating the resistance, conductivity;</p> <p>2.44 be able to make decisions independently and efficiently in the educational and professional activity;</p> <p>2.45 be able to carry out the organization of the provision of first aid to victims;</p> <p>2.46 observe general fire safety requirements in planning facilities of industrial enterprises and electrical installations;</p> <p>2.47 observe the fire safety requirements when operating electrical installations and during welding works;</p> <p>2.48 to comply with fire safety in repair shops, maintenance centers, fuel, combustible and flammable materials stores;</p> <p>2.49 use in the professional activity terms and definitions adopted in fire safety;</p> <p>2.50 implement security measures when working with electrical installations of special purpose, safety measures when working in the laboratories of industrial enterprises;</p> <p>2.51 be able to use the means of protection against electric shock</p>
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BGPM.03 - Diagnostics of electrical machines and apparatuses

Purpose: Determination of the actual technical condition of the equipment for the organization of its proper operation, maintenance and repair, as well as identification of possible malfunctions of the electromagnetic processes, electro-mechanical transformation, analysis and calculation of static and static and dynamic.

Objectives: To have a clear understanding of the physical processes occurring in electric to know the working principle and the main characteristics of electrical machines; to understand the role of electric power in modern society, and as a basis for the mechanization and automation of production processes; to understand the general principles of electrical and electrical engineering devices in order the future specialist can solve production tasks related to rationalization, inventions and reconstruction of technological equipment;

Content of the module:

Section 1. Electric devices. Electric and electronic devices as a means of control of modes of operation, protection and control of technical systems parameters. Thermal measuring instruments. Temperature measuring instruments. Physical phenomena in electric devices. Pressure and the pressure difference measuring devices. Flow measuring and control instruments. Electromechanical automation devices. Heat amount metering tools. Application and operation of electric devices.

Section 2. Electric machines. The theory of generalized electric machine. The equation of the generalized electric machine. The main types of AC machines and their comparative analysis. Electromotive force of AC windings. The magnetic field of the polyphase winding. Asynchronous and synchronous speed.

Section 3. Asynchronous machines. The types of asynchronous machines. Design of commutatorless asynchronous machines. The principle of operation of the asynchronous machine. Sliding motion. Operation mode. Bringing the asynchronous machine to the diagram of the generalized electrical machine. Energy diagram of operation of the asynchronous motor. Mechanical and rheostat characteristics. Stable operation. Control of the operating speed and motor reversing. Launching the asynchronous motor. Braking modes. The principle of operation of the single-phase asynchronous motor. Features of single-phase asynchronous motors (motor with starting winding, condenser motor, motor with high rotor winding resistance, motor with hollow rotor).

Laboratory work № 3 The study of a three-phase asynchronous motor with squirrel-cage rotor.

Laboratory work №4 The study of a three-phase asynchronous motor by method of idle run and short circuit.

Laboratory work №5 Defining the beginning and the end of the asynchronous motor stator windings.

Laboratory work № 6 The study of the ways of launching three-phase asynchronous motors.

Section 4. Synchronous machines. Design of synchronous machines: types, principle of operation, modes of operation. The operating principle of a three-phase synchronous generator. The principle of operation of the synchronous motor. Simplified vector diagram of the phase of synchronous motor. Angle and U- shaped characteristics. Stable operation. Asynchronous starting of synchronous motors.

Advantages and disadvantages.

Direct current electric machines. DC machines. Types. The operating principle of the DC generator. Design and principle of operation of commutator motor.

Laboratory work № 7 The study of three-phase synchronous generator and motor.

Laboratory work №8 The study of three-phase synchronous generator, concurrently operating with the network.

Section 5. The operating principle and design of DC commutator machines. Armature windings of DC machines.

The principle of the implementation of the armature windings. Types of windings: simple, lap, simple wave, complex lap, complex wave and combined. The DC commutator motors of parallel, series and mixed excitation - connection circuits, the operating principle, the main characteristics, the scope of use.

The DC commutator motor of series excitation, universal commutator motor - design features, characteristics, scope of use. Adjustment properties of commutator motors. The principle of operation of commutatorless AC machines. The principle of implementation and basic types of stator windings. The principle of implementation of stator winding (armature); the concept of a coil (section), the pole division, slop pitches. EMF of winding conductor. Schedule of distribution of magnetic induction in the air gap of the machine.

Laboratory work №9 The study of the DC generator and DC motor of parallel excitation

Section 6 Classification of generators. Main parameters. Generators of linear oscillations

Pulse signal parameters. The operating principle of the simplest pulse signal shapers. Principles of operation of multivibrators and univibrators. The principle of operation of the circuits. Diagrams explaining the principle of operation of the circuits. Purpose and scope of logic elements and adders. Scheme of implementation of the logical elements.

Logical elements. Purpose and scope of logic elements and adders. Schemes of implementation of the logical elements.

Laboratory work №10 Transistor logic elements.

Learning Outcomes	Assessment criteria
Upon successful completion of this module the student:	
PO03 Умеет выполнять диагностику электрических машин и аппаратов	Has to: 3.1 own professional vocabulary; 3.2 be able to organize the workplace; 3.3 carry out works under the supervision of specialists of higher qualification; 3.4 understand the nature and the social importance of the future profession, show a steady interest to it; 3. 5 be able to work in a team, communicate effectively with colleagues, management, customers; 3.6 apply the basic regulatory requirements according to Electrical installation code, Fire safety rules, Safety rules; 3.7 have electrical circuits reading skills; 3.8 use information and communication technologies to improve the professional activity.

	<p>3.9 determine the electrical materials, magnetic materials; conducting materials; wires, tires, cables; semiconductor materials by the properties and scope of use;</p> <p>3.10 explain the purpose of insulating materials, gaseous dielectrics, polarization materials, electrical insulating materials.</p> <p>3.11 explain the structure and principle of operation of DC machine; wiring of DC generators; DC motor; principle of operation of start-up engine; performance; construction and principle of operation of the transformers; modes of operation;</p> <p>3.12 identify groups and connection schemes of transformers; autotransformers, three-winding and special transformers;</p> <p>3.13 explain the structure and function of synchronous generators; principle of operation and structure of synchronous and asynchronous motors.</p> <p>3.14 be able to determine the elements of automation systems, sensors of automation systems, amplifying mechanisms, actuators, automatic control systems;</p> <p>3.15 explain the theories of automatic control systems;</p> <p>3.16 distinguish logic elements;</p> <p>3.17 read and make simple electronic circuits based on simple logic elements;</p> <p>3.18 analyze time schedules and diagrams, instrumentation and control equipment;</p> <p>3.19 work with catalogs and reference books;</p> <p>3.20 be able to work with circuits of current and voltage transformers, auto-transformers</p> <p>3.21 apply the laws of electrical engineering;</p> <p>3.22 calculate and construct a detailed diagram of the windings;</p> <p>3.23 eliminate arcing in electrical machines;</p> <p>3.24 collect motor circuits and take characteristics;</p> <p>3.25 solve problems on the calculation of parameters and the implementation of the detailed diagrams of the winding of the armature; calculation of magnetic DC circuit; calculation of EMF and MMF of the windings, electromagnetic torque and operating speed of commutator cars; calculation of losses and efficiency; calculation of electromagnetic torque and power; calculation and development of characteristics of the machines of direct and alternating current;</p> <p>3.26 perform assembly of switching circuit of DC machines, asynchronous and synchronous motors;</p> <p>3.27 select instrumentation and ballasts;</p> <p>3.28 measure, be able to work with wiring and plumbing tools;</p> <p>3.29 identify the causes of malfunctions and failures of electrical equipment associated with electrical engineering materials;</p> <p>3.30 understand the issues of depending the quality of repair and installation works on the choice of electrical engineering material;</p> <p>3.31 select a brand of a winding wire;</p> <p>3.32 perform selection of an electrically insulating material for electrical machines of direct and alternating currents according to heat resistance and electric strength;</p> <p>3.33 measure the frequency phase, phases shift by devices;</p> <p>3.34 measure the level of insulation, the insulation quality;</p> <p>3.35 perform testing of insulation by voltage increase;</p> <p>3.36 measure the insulation resistance;</p> <p>3.37 perform temporary and speed rating of circuit breakers;;</p>
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	<p>3.38 measure the dielectric losses tangent;</p> <p>3.39 to measure the resistance of the windings of DC electrical machines;</p> <p>3.40 determine the polarity of the windings;</p> <p>3.41 to set the brushes on the neutral of the machine;</p> <p>3.42 identify structural elements of apparatuses;</p> <p>3.43 draw schemes of hooking up the devices into the electrical network and perform their selection</p> <p>3.44 determine structural elements of apparatuses, transformers measuring current and voltage;</p> <p>3.45 perform operations with switching devices;</p> <p>3.46 be able to decipher the brand of motors and transformers;</p> <p>3.47 carry out organizational arrangements for health and safety during repair works in electrical installations;</p> <p>3.48 use protection devices against harmful industrial factors;</p> <p>3.49 apply safety rules during the installation of electrical machinery, electrical equipment and electrical wiring;</p> <p>3.50 implement security measures during the operation of portable power tools and portable electrical installations;</p> <p>3.51 implement security measures when working on electrical installations of special purpose;</p> <p>3.52 comply with the general rules of electrical safety during the operation of active electrical installations;</p> <p>3.53 observe safety requirements during electrical equipment repair;</p> <p>3.54 observe safety rules during mechanical and machine tool works, the requirements of occupational safety during welding and soldering;</p> <p>3.55 perform the safe use of manual electrified tools and portable lamps;</p> <p>3.56 apply a resistance normalization of grounding devices;</p> <p>3.57 be able to use residual cut-off devices;</p> <p>3.58 fulfill the requirements for residual cut-off devices on industrial plants;</p> <p>3.59 be able to use electrical safety devices used in electrical installations;</p> <p>3.60 remember the order of use, purpose and content of the electrical safety devices. 2.60 explain posters and signs on safety;</p> <p>3.61 organize the process of operation of electrical and electromechanical equipment;</p> <p>3.62 carry out maintenance and repair of electrical and electromechanical equipment;</p> <p>3.63 keep n approved documentation of the structural unit;</p> <p>3.64 analyze and evaluate the economic efficiency of production activity of the structural division;</p> <p>3.65 explain the purpose of pulse-width modulation converters (PMC) on thyristors;</p> <p>3.66 to carry out maintenance of electrical and electronic devices, as the means of operation mode control, protection and control of technical systems parameters;</p> <p>3.67 able to apply hybrid electric vehicles as intended;</p> <p>3.68 be able to use the temperature measuring instruments;</p> <p>3.69 explain the nature of physical phenomena in electrical machines;</p> <p>3.70 apply pressure and the pressure difference measuring means;</p> <p>3.71 use flow measuring and controlling instruments, heat amount metering devices as intended;</p>
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	3.72 apply the properties of metals, conductive materials; wires, tires, cables; 3.73 identify alloys of iron with carbon, non-ferrous metals and their alloys, electrotechnical materials, hard-magnetic materials; 3.74 explain the scope of the electrical insulating materials, gaseous dielectrics, polarizing materials and electrical insulation materials.
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PM. 00 Professional (special) modules

PM.01 Maintenance of electric installations and automation devices

Purpose: To form a system of theoretical and practical knowledge in the field of electric actuator and electrical equipment capable of solving the practical problems of agricultural production effectively, as well as contributing to the further development of the individual.

Objectives: Study the scientific and technological achievements in the field of modern electric actuators and electrical equipment in areas of agricultural production; learn to rate the electric actuators and to select, operate electrical equipment for machines and installations of agricultural production;

Content of the module:

Fundamentals of the electric actuator. Mechanical characteristics of electric actuators. Transients in electric actuators. Calculation of power in electric actuators. Energy of electric actuators. Equipment for control and protection of electric motors. Automatic control of electric actuators. Electric actuators of machines, aggregates and in-line machines. Features of the operation of electric actuators in the conditions of agricultural production.

Electric actuator of ventilation systems. Electric actuator of feeders and transport facilities. Electric actuator of milking machines and milk primary processing machines. Electric actuator of shearing machines. Electric actuator of machines and units of grain cleaning points and aggregates. Electric actuator of metal and woodworking machines and stands for running engines. Technical - economic basis for the application of electric energy of thermal and heating processes in agricultural production. The methods and apparatus for converting electrical energy into thermal. Electric water heaters and boilers. Electric heating installations for the creation and regulation of microclimate. Electric heating installations for thermal treatment and drying of agricultural products and feeds.

Learning Outcomes	Assessment criteria
Upon successful completion of this module the student:	
LO1 Operate electrical equipment and automation devices	Has to: 1.1 be able to organize the workplace; 1.2 own professional vocabulary; 1.3 carry out works under the supervision of specialists of higher qualification; 1.4 know computer methods for data collection, storage and processing; 1.5 be able to work in a team, communicate effectively with colleagues, management, customers; 1.6 apply the basic regulatory requirements according to Electrical installation code, Fire safety rules, Safety rules; 1.7 be able to work with wiring and plumbing tools;

	<p>1.8 have electrical circuits reading skills;</p> <p>1.9 use information and communication technologies to improve the professional activity;</p> <p>1.10 be able to work with reference books and catalogs;</p> <p>1.11 explain the purpose of electrical substations, power transformers, step-down electrical substations with voltage up to 110 kV; high-voltage equipment of substations, short-circuits, the distribution of group lighting boards;</p> <p>1.12 perform selection of cable transmission lines equipment; analysis of simple closed networks, section analysis of supply and group network by the permissible current and voltage loss;</p> <p>1.13 perform selection of wire brand and cabling method; use the classification of equipment by its purpose, the principle of operation, characteristics of configuration, selection criteria.</p> <p>1.14 apply in practice the rules for safe operation, labor protection, legal and regulatory framework;</p> <p>1.15 identify occupational injury and disease and determine the factors affecting the working conditions;</p> <p>1.16 be able to perform the analysis of the cross section of supply and group network by allowable current and voltage loss; perform the analysis of simple closed networks;</p> <p>1.17 use information about power consumers;</p> <p>1.18 estimate and select an electric actuator, control, protection, switching devices; draw schemes, read schemes;</p> <p>1.19 select an electric motor, protection and switching devices, automation components; read schemes;</p> <p>1.20 calculate the power of the main actuator and auxiliary electric actuators;</p> <p>1.21 select the type and capacity of the motor, check the EA;</p> <p>1.22 design simple control schemes, analyze brake modes;</p> <p>1.23 choose devices and control system, contactless EA control circuits;</p> <p>1.24 select electric machines and equipment according to category B or P according to Electrical installation code;</p> <p>1.25 select the type and power of EA;</p> <p>1.26 select switching, protective equipment;</p> <p>1.27 choose for each mechanism type and power of electric motor;</p> <p>1.28 constitute a control scheme and select electrical equipment;</p> <p>1.29 select the type and power of EA and select switching, protective equipment;</p> <p>1.30 select an electric actuator and electrical equipment according to the operation and category of placement; control schemes, automation system;</p> <p>1.31 select switching and protective equipment;</p> <p>1.32 perform necessary calculations;</p> <p>1.33 use the obtained knowledge to solve practical problems on the design, installation, adjustment, testing and commissioning of the modern electric actuator, proper operation and maintenance of the electric actuator, the use of modern information technologies and software packages for experimental studies on the model of the electric actuator in different static and transient modes;</p> <p>1.34 execute results of the calculation and analysis in accordance with USED.</p>
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	<p>1.35 diagnose damage to electrical equipment in industrial enterprises, analyze the causes of failures of an electric equipment of electric power systems;</p> <p>1.36 perform calculation of the power and selection of the electric actuator for different kinds of working machines;</p> <p>1.37 draw a kinematic scheme of EA;</p> <p>1.38 carry out the maintenance and operation of electrical machines and transformers, substations and distribution networks;</p> <p>1.39 read lighting control schemes;</p> <p>1.40 check and adjust the security settings by primary current at all kinds;</p> <p>1.41 perform connections of secondary current circuits;</p> <p>1.42 check and configure the protection against single-phase earth faults;</p> <p>1.43 check and configure the protection against undervoltage;</p> <p>1.44 kinematic schemes of inspected devices;</p> <p>1.45 testing standards of AC circuit breakers;</p> <p>1.46 testing standards of DC circuit breakers;</p> <p>1.47 identify the causes of malfunction of the switch;</p> <p>1.48 adjust the kinematics of the switch;</p> <p>1.49 take time-current characteristic of the switch;</p> <p>1.50 apply safety rules during the works on repair of electrical switchgears;</p> <p>1.51 perform organizational arrangements for health and safety during electrical works, safety measures when installing switchgear and conductors;</p> <p>1.52 be able to carry out the organization of occupational health, safety, industrial hygiene and fire protection;</p> <p>1.53 comply with the terms of electrical safety in networks with voltage up to 1000 V;</p> <p>1.54 assess the insulation of the wires and the mode of operation of the neutral point of the network as electrical safety factors;</p> <p>1.55 apply insulation of conductive parts;</p> <p>1.56 use portable lights and automatic voltage signaling devices as intended;</p> <p>1.57 be able to apply the protective earthing and disconnection;</p> <p>1.58 relieve the victim from the action of an electric current;</p> <p>1.59 provide first aid to the victim of the current action;</p>
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PM.02 Electricity supply

Purpose: Formation of a system of knowledge and practical skills needed to solve problems related to electricity supply in rural settlements, buildings, businesses, farms and country farmsteads.

Objectives: To show the quality of electrical energy and its standard values. Influence of the quality of electrical energy on the work of power consumers and measures to improve the quality of electrical energy. Control of the quality of electricity. Reliability of power supply. Requirements for the reliability of consumers' power supply of first, second and third categories.

Content of the module:

General information about the production, transmission and distribution of electric energy. Wires, cables and their selection by the permissible heating. The structure

of internal wires and cable lines. Graphs of loads and energy losses in the electrical networks. Acceptable voltage losses in the network. Calculation of open networks in a uniform and non-uniform load. Calculation of closed networks. The equipment and the conductor of the switchgear. Control - measuring instruments and measuring transformers. Rural transformer substations and reserve power stations. Calculation of short circuit currents and earth fault currents. Relay protection. Automation of power plants and substations. Protection against atmospheric overvoltage. The gearmesh and gearmesh devices.

Practical work №1. Calculation of the electrical load by method of demand factor

Practical work № 2. Calculation of the electrical load by method of capacity factor

Practical work №3. Building a daily schedule of electric load according to duration

Practical work №4. Calculate electrical loads of industrial enterprises.

Practical work №5. Selecting protective switchgear and conducting products, taking into account the choice of fuse protection devices.

Practical work №6. Drawing up load graphs for various industries.

Practical work № 7. Determination of active, reactive, full power by the shops to select the power transformers at substations in shops.

Practical work № 8. Determination of power losses in separate elements of the power supply system, measures to reduce them.

Practical work №9 Selecting discharge resistance.

Practical work №10 Calculation of power of compensating device with a choice of the type and place of installation of capacitor banks

Practical work № 11 Solving the tasks on the given terms to determine the number and power of transformers at the substation

Practical work № 12 Calculation of short circuit currents in power supply system (4h)

Practical work № 13 Selection and verification of the busbars of conducting products

Practical work № 14 Solving tasks on short circuit currents operation and selection of high-voltage devices

Practical work № 15 Selection and verification of current-limiting devices

Practical work №16 To study the technique of first aid to the victim from the effects of electric current.

Learning Outcomes	Assessment criteria
Upon successful completion of this module the student:	
PO 02 Is able to serve and supply agricultural enterprises, intrashop enterprises with power.	Has to: 2.1. be able to organize the workplace; 2.2 own professional vocabulary; 2.3 carry out works under the supervision of specialists of higher qualification; 2.4 know computer methods for data collection, storage and processing; 2.5 be able to work in a team, communicate effectively with colleagues, management, customers; 2.6 apply the basic regulatory requirements according to Electrical installation code, Fire safety rules, Safety rules. 2.7 be able to work with wiring and plumbing tools;

	<p>2.8 have electrical circuits reading skills;</p> <p>2.9 use information and communication technologies to improve the professional activity;</p> <p>2.10 be able to work with reference books and catalogs;</p> <p>2.11 explain the features of the system of power supply of agricultural enterprises; intrashop power supply of enterprises; the main step-down substations (MSS);;</p> <p>2.12 distinguish power and lightening equipment;</p> <p>2.13 classify electric receivers according to the degree of security of electricity supply and modes of operation;</p> <p>2.14 determine the protection of electrical networks in installations up to 1000 V;</p> <p>2.15 read power supply circuits with voltage up to 1000 V;</p> <p>2.16 apply electric receivers classification according to the degree of security of electricity supply and modes of operation;</p> <p>2.17 read power supply circuits with voltage up to 1000 V;</p> <p>2.18 apply electric receivers classification according to the degree of security of electricity supply and modes of operation;</p> <p>2.19 evaluate the protection of electrical networks in installations up to 1000 V, power supply of agricultural enterprises;</p> <p>2.20 be able to distinguish power supply circuits with voltage up to 1000 V;</p> <p>2.21 understand the purpose of the main step-down substations (MSS); protection of electrical networks in installations up to 1000 V;</p> <p>2.22 calculate the power and select electrical motors for various operating machines;</p> <p>2.23 select necessary equipment depending on the technical requirements;</p> <p>2.24 perform the calculation of electrical loads on the substation sites (DP, DPA, MCC);</p> <p>2.25 carry out calculation of short circuit currents;</p> <p>2.26 verify equipment for thermal and dynamic stability according to cartograms of electrical loads;</p> <p>2.27 select schemes of internal and external power supply of plants and concerns;</p> <p>2.28 choose the power transformer according to the categorization and allowed overload;</p> <p>2.29 calculate grounding devices and their performance;</p> <p>2.29 solve issues on designing switchgears;</p> <p>2.30 draw up relay protection circuit;</p> <p>2.31 select relay;</p> <p>2.32 draw up and read control, accounting and alarm circuits;</p> <p>2.33 read the circuits of automatic transfer switch (ATS), AR;</p> <p>2.34 select protection and electrics for the power supply networks of industrial enterprises and civil buildings;</p> <p>2.35 draw up and read control, accounting and alarm circuits;</p> <p>2.36 use in production activity modern technical means of electric energy accounting;</p> <p>2.37 select electric energy accounting system for the enterprise and its structural units;</p> <p>2.38 carry out the installation of lighting wiring, installation of grounding of electrical equipment;</p> <p>2.39 perform resistance measurement of electrical circuits, windings of electrical machines and apparatus; verify insulation of electrical equipment;</p> <p>2.40 draw up electric circuits of lightening installations;</p>
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	<p>2.41 perform the installation of the lighting wiring, installation of grounding of electrical equipment;</p> <p>2.42 measure the resistance of electrical circuits, windings of electrical machines and apparatuses;</p> <p>2.43 calculate grounding devices and their performance;</p> <p>2.44 test insulation of various types of electrical equipment;</p> <p>2.45 determine the currents of protective devices installations (filaments, releasers of circuit breakers, relays);</p> <p>2.46 select the number and power of transformers at substations;</p> <p>2.47 draw cartogram of loads;</p> <p>2.48 perform selection of the number and location of substations;</p> <p>2.49 choose the transformer capacity depending on the operating mode;</p> <p>2.50 choose the section and construction of conductors in a variety of electric networks;</p> <p>2.51 select high-voltage equipment for electric power supply systems;</p> <p>2.52 apply the "Regulations on the investigation and recording industrial accidents";</p> <p>2.53 apply the "Regulations on the investigation of non-production injury";</p> <p>2.54 own methods of organization of inspection and safety assessment of production processes in the industry;</p> <p>2.55 apply normative-technical, design, organizational, administrative and other documentation for the thoroughness of safety requirements and their compliance with applicable laws, rules and regulations;</p> <p>2.56 own fire-fighting techniques in different conditions;</p> <p>2.57 determine active and reactive resistance of wires and cables;</p> <p>2.58 determine active and reactive conductivity of power lines, charging currents and power of lines;</p> <p>2.59 determine active and inductive resistance and conductivity of two- and three-winding transformers;</p> <p>2.60 determine capital expenses for the construction of electrical network and annual costs for operation and maintenance of network facilities</p> <p>2.61 choose the sections of the wires by the method of economic intervals;</p> <p>2.62 choose the sections of wires and cable cores with taking into account the construction of electrical networks, type of protection and conditions of laying electric lines;</p> <p>2.63 carry out calculations of equivalent circuits of PTL of local electrical networks, equivalent circuits of transformers;</p> <p>2.64 perform calculations of power and electric energy losses in electrical lines by various methods;</p> <p>2.65 carry out selection of wire and cable cores according to economic current density by method of economic intervals;</p> <p>2. 66 carry out selection of fuse-links and circuit breakers installations on the conditions of permissible heating;</p> <p>2.67select the sections of wires and cable cores on the permissible heating;</p> <p>2.68 determine the voltage losses in the electrical lines of three-phase current by several consumers;</p> <p>2.69 determine the highest voltage loss;</p> <p>2.70 identify points of the flow division;</p> <p>2.71 perform the calculation of voltage losses in two-wire lines, in lines of three-phase current and the highest voltage losses;</p> <p>2.72 determine the loss of selected sections of wires and cable cores on the permissible voltage loss;</p>
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	2.73 perform the calculation of the closed local power supply network by several energy consumers; 2.74 select the operating voltage of the electric network by comparing the options; 2.75 determine the reliability of the elements of electrical networks by structural schemes; 2.76 backup power supply schemes of the local electric networks; 2.77 determine the nominal voltage of the electrical network according to the load and the length of the line;; 2.78 carry out technical and economic calculations when selecting schemes of networks taking into account the damage caused by interruptions in the power supply; 2.79 read electrical networks circuits of power lines; 2.80 determine the mechanical load on the wire and the maximum allowable voltage in the metal of wires; maximum wire sag; 2.81 perform the calculation of wires of AC brand on the mechanical load; 2.82 choose the transformer capacity depending on the operating mode; 2.83 choose the section and construction of conductors in various electrical networks and insulators for their fastening;
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PM.03 Norms of standardization and metrology in the process of agricultural production

Purpose: Formation of knowledge in learning the basics of standardization, the current state, problems and ways to improve standardization, quality requirements for the finished product on the basis of standardization of its qualitative characteristics, as well as the characteristics of the materials and components;

Objectives: Development and establishment of a unified system of indicators of the methods and means of monitoring and testing, as well as the required level of reliability of the products in accordance with their purpose and conditions of use; establishment of standards, requirements and methods in the design and manufacture in order to ensure optimal quality and to avoid unreasonable diversity of types, brands and sizes of products; development of industrial unification, improvement of the level of interoperability, efficiency of operation and maintenance of equipment; ensuring the unity and reliability of measurements, establishment of uniform documentation systems;

Content of the module: Terms and definitions in metrology. The role and importance of measurements in science and engineering. Measures of basic electrical values. Classification of errors in measurements. The principle of operation, structure and scope of use of devices in the magneto-electric, electromagnetic, electrostatic, electrodynamic, ferrodynamic, induction systems. The error by the transformation coefficient. The angular error. Optoelectronic measuring transformers. Selection of resistors for adjusting the current and voltage. Selection of adjusting autotransformers. Types of load devices. Measurement of parameters of inductors and capacitors. Measurement of active and reactive energy in the single- and three-phase circuits. Watt metering method for determining losses in iron. Separation of the losses in iron. Compensation method of measurement. Potentiometers. Basic principles of measurement of non-electric values by electric methods. Measuring converters of non-electric values, their classification and practical application.

Laboratory work №1 Selection of adjusting and load devices.

Laboratory work №2 Resistance measurement by indirect method.

Learning Outcomes	Assessment criteria
Upon successful completion of this module the student:	
LO 03 Introduce norms of standardization and metrology in the processes of agricultural production; understands the nature of standardization, initial position of standardization, state systems of standardization in RK, standardization and product quality.	<p>Has to:</p> <ul style="list-style-type: none"> 3.1 be able to organize the workplace; 3.2 own professional vocabulary; 3.3 carry out works under the supervision of specialists of higher qualification; 3.4 know computer methods for data collection, storage and processing; 3.5 be able to work in a team, communicate effectively with colleagues, management, customers; 3.6 apply the basic regulatory requirements according to Electrical installation code, Fire safety rules, Safety rules; 3.7 be able to work with wiring and plumbing tools; 3.8 have electrical circuits reading skills; 3.9 use information and communication technologies to improve the professional activity; 3.10 be able to work with reference books and catalogs; 3.11 explain nature of standardization, initial position of standardization, state systems of standardization in RK; 3.12 apply basic features of the unified system of fits and tolerances, standardization and product quality, the general principles of interoperability; 3.13 apply the basic concepts of fits and tolerances; 3.14 evaluate the accuracy of the geometric parameters of parts; 3.15 apply basic metrological concepts and definitions; 3.16 distinguish between universal and special measuring instruments; 3.17 select means to perform the measurement of linear values; 3.18 use the system of fits and tolerances of the couplings; 3.19 carry out selection of fits and tolerances; 3.20 explain the general principles of interchangeability, the main features of the unified system of fits and tolerances; 3.21 apply basic concepts of fits and tolerances; 3.22 evaluate the accuracy of the geometric parameters of parts; 3.23 be able to determine the universal and special measuring instruments; 3.24 explain the significance of the system of fits and tolerances of couplings; 3.25 use the means and methods of errors; 3.26 ensure the unity and accuracy of measurements; 3.27 apply physical values and their systems; 3.28 apply methods and means of measurements; 3.29 carry out the transfer of units dimensions from standard to exemplary and operating measuring instruments; 3.30 perform calibration and verification of measuring instruments; 3.31 apply the basics of legal metrology; 3.32 use national and international norms and standards; 3.33 explain the purpose of the metrological service; 3.34 explain the purpose of the system of certification, certification of measuring instruments; 3.35 explain the purpose of the state metrological control and supervision, verification, calibration and certification of measuring instruments;

	3.36 apply theoretical and methodological foundations of standardization; 3.37 apply the standards of the state system of standardization, cross-industry standards, standardization of electrical materials and electrical equipment; 3.38 use in the practice the norms of standardization of technical documentation normative control; 3.39 explain the technical and economic efficiency of standardization; 3.40 explain the purpose of quality control as indicators of products quality; 3.41 apply methods for evaluating the level of quality control: planning, certification and quality management; 3.42 master the skills of organization and types of technical quality control; 3.43 explain the purpose of the state certification and product certification system: the legal framework of standardization and product quality assurance; 3.44 be able to use in the practice metrology – measurement units; 3.45 select the means and methods for determination of measurement errors; 3.45 distinguish metrological characteristics of measuring instruments: measurement of linear and other values.
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Mid-ranking specialist

151803 – 3 - Electrical technician

BGMP.00. Basic general professional modules

BGMP.01. Records keeping in the state language

Purpose: To form records keeping according to the specialty.

Object: According to the requirements for records keeping in the state language know how to issue documents in the state and Russian languages, work with technical dictionaries, know requirements for technical documentation, send and receive electric devices for maintenance.

Learning Outcomes	Assessment criteria
upon successful completion of this module the student:	
LO 01 Can communicate and keep records in the state language	has to: 1.1. understand the nature and the social importance of the state language in future profession, show a steady interest to it; 1.2 own professional vocabulary; 1.3 keep records in the state language; 1.4 apply the structure of documentation service, job structure, job duties, technology of documentation through technical means; 1.5 prepare and execute the administrative and organizational documents, official correspondence in the state language; 1.6 be able to work with documents from the moment they arrive to the registration of cases; 1.7 work with documents from the moment they arrive.

BGPM. 02. Basics of Agronomy and Livestock

Purpose: to master the basics of soil science, agriculture, agrochemicals, irrigation, crop growing, anatomy, physiology, breeding and feeding farm animals, production technology of the basic elements of agriculture, peculiarities of crop growing and livestock breeding.

Objective: formation of knowledge on morphological, biological and economic

features of crops, methods of cultivation. Formation of knowledge on agriculture and the need for crop and livestock industry.

Content of the module:

Module 1. Basics of Agronomy. The soil, its origin, composition and properties. The general scheme of soil-forming process. Factors and conditions for soil-forming. The origin and composition of the mineral part. Granulometric composition of the soil and its effect on agronomic characteristics and fertility. Organic matter of the soil. The composition and significance of humus in the soil formation and fertility. Soil structure and its significance. The main physical, physical-mechanical, air, water and thermal properties of soils and methods to improve them. The concept of soil classification. The main types of soils and their agricultural use.

Laboratory work № 1. Determination of the main types of soils of zones by monoliths and samples.

Module 1.2. Optimization of plant living conditions and reproduction of soil. Requirements of crops for basic living factors. Earth and cosmic factors. Agriculture laws. Law of indispensability and equivalency of factors of plant life, the laws of minimum, optimum and maximum and their manifestation in countries in different zones. The laws of the cumulative effect of factors of plant life and the return of substances to the soil. The concept of reproduction of fertility and cultivation of soils. Methods of optimizing the living conditions of plants and ways of reproduction of soil fertility.

Module 1.3. Weeds, pests and diseases and measures against them. The concept of weeds, their main types. The damage caused by weeds. Classification and biological features of weeds. Agronomic, biological and chemical methods against weeds. Comprehensive measures against weeds. Herbicides, methods for their use in agriculture. Safety requirements when working with herbicides. Environmental protection.

The concept of pests and diseases of crops. Measures against them.

Practical class №1 Determination of weeds, pests and diseases by herbaria.

Module 1.4. Crop rotations. The concept of crop rotation, replicate, permanent and interplanted crops.

Scientific causes of crops interchange in crop rotation. The role of crop rotation in reproduction of soil fertility and its protection from erosion. Features of predecessors. Couples and their classification.

Classification of crop rotation. Principles of crop rotation. Design, development and introduction of crop rotation. Agronomy and economic assessment of crop rotation.

Practical class № 2 Preparation of schemes of crop rotation and rotary tables.

Module 1.5. System of tillage. Objectives of tillage. Processing operations in tillage. Tools for basic tillage. Special methods of tillage. Tools for a special tillage. Methods of surface tillage. Agronomy requirements for working parts of machines and for techniques of basic and surface tillage. Influence of physical maturity of the soil on the quality of its processing. System of tillage for winter and spring crops. The system of pre-sowing tillage. Crops maintenance. Fallow and semi-fallow tillage. Evaluation of the quality of field works.

Practical class №3 Preparation of systems of tillage for winter and spring crops.

Module 1.6. Fertilizers and their use. The role of fertilizers in improving soil fertility, increasing the quantity and improving the quality of agricultural crops. Theoretical foundations of the plant nutrition.

Macro and microelements necessary for plant nutrition. Classification of fertilizers. Mineral fertilizers, their properties and application. Lime fertilizers and methods of their use. Storage, dose, timing and methods of application of mineral fertilizers. Liquid complex fertilizers, their storage, dosage, timing and methods of application

Organic fertilizers, their storage, compost preparation technology, dose, timing and methods of application. Green fertilizers. Requirements for the mechanical means for fertilizers application. Understanding the system of application of fertilizers in crop rotation. Cost-effectiveness of the science-based use of fertilizers, ensuring the delivery of planned harvests. Using mathematical modeling and computer systems for the development of the system of fertilizers. Protection of the environment and quality control of crop products.

Practical class №4. Calculation of doses of fertilizers for the planned harvest.

Module 1.7. Zonal crop farming systems. The concept of the crop farming system. Crop farming system in this zone. Basic units of modern crop farming systems. Design principles of crop farming systems on a regulatory basis. Contour-reclamative and landscape systems of crop farming.

Module 1.8. Land reclamation and protection of soil from erosion. Reclamation as a means of radically improving the soil fertility. Types of land reclamation. Irrigation reclamation. Irrigation modes and using irrigation technique. Modern ways and methods of irrigation. Irrigation reclamation. Drying modes. Using dried lands. Concept of soil erosion and its causes. Antierosion organization of the territory and the complex of agro-technical, hydrotechnical, forest reclamation measures to protect soil from erosion. Antierosion tillage methods in different soil and climatic zones.

Module 1.9. The technology of cultivation of major crops. The seeds, their sowing and varietal quality, variety changing and strain renovation. Preparation of seeds for sowing. Sowing. Timing, methods of sowing, drilling depth and seeding rate. Agro-technical requirements for the technical state of seeders and crop quality.

Small grains. Increase of grain production and improving its quality. Winter and spring crops, planting acreage, yielding capacity. The morphological features of small grains. Biological features of small grains of I and II groups. Fundamentals of programming yield capacity. Technology of cultivation of basic small grains of the zone. Economic efficiency of cultivation of small grains. Grain legumes. The role of grain legumes in increasing the production of grain, solving problems of plant protein and improving soil fertility. The morphological features and biological characteristics of grain legumes. Technology of cultivation of major grain legumes of the zone. Economic efficiency of cultivation of grain legumes.

Tuber crops, their importance as food, industrial and feed crops. The morphological features and biological characteristics of tuber crops. Potato cultivation technology. Economic efficiency of cultivation of tuber crops. Fiber crops. Linen, morphological characteristics and biological features. Influence of seeding rate and population on the mechanized processing of crops. The use of harvesting and transport complexes

in winning fiber crops. Perennial legumes and grasses, their importance for the production of high-quality protein feed. The morphological features and biological characteristics of perennial grasses in field crop rotations for feed and seeds. Methods of harvesting, drying and storing hay. Economic efficiency of cultivation of forage grasses. Vegetable crops, their significance, morphological characteristics and biological features. Features of cultivation of vegetable crops in open and frame area. Economic efficiency of cultivation of vegetable crops.

Laboratory work № 2. Determination of purity, germination and sowing suitability of seeds, calculation of the norms of seeding.

Determination of major crops by morphological characteristics. Making technological maps of cultivation of vegetable crops.

Practical work №5-7 Making technological maps of pea cultivation. Making technological maps of potato cultivation. Forage grasses. Perennial grasses and leguminous grasses. Standardization of feed.

Module 2.1. Fundamentals of livestock breeding. Fundamentals of anatomy and physiology of crops.

Understanding the anatomy and physiology as biological sciences. The organism as a whole. Structure and function of cells. The concept of the tissues, organs, apparatuses and systems of the animal body.

The structure and functions of the skeleton, muscles, skin and breast. Structure and functions of the heart, the significance of the cardiovascular system. Structure and functions of the respiratory organs. Digestive system. The structure and function of single-chamber and multi-chamber stomach. Metabolism and energy. System of organs of urinary and reproduction. Excitatory system. Reflex and its significance.

Practical work №8. Determination of the structural features of the skeleton and digestive system of animals.

Module 2.2. Fundamentals of breeding and feeding farm animals. Origin, domestication and evolution of farm animals. The constitution, the exterior and interior, their significance and assessment methods. The concept of growth and development of animals. The main types of productivity of agricultural animals, their registration and evaluation.

Breeds of farm animals and birds, their classification. Standardization of breeds. Breeding methods, their essence and economic value. Selected-brood work. The production, zootechnical and brood records in livestock breeding. Chemical composition and nutritional value of feed. Classification and brief description of the feed, preparing them for feeding. Accounting and assessment of the quantity and quality of feed. Standards for feed. Feed storage. Fundamentals of standardized feeding. The concept of the diets, the general principles of their compilation.

Practical work №9. Study of nutritional value of feed.

Module 2.3 Technology of production of major types of livestock. Cattle breeding. Current state and prospects of development of the sector. Main planned breeds of cattle. Animal stock reproduction technology. The main types of enterprises in dairy cattle breeding. Dimensions of farms. Systems, methods and techniques of keeping, feeding, milking animals and manure disposal in the winter and summer periods.

Pig breeding. Current state and prospects of development of the sector. Biological

and economic characteristics of pigs. Classification and basic breeds of pigs. The reproduction of the animal stock. Dates of economic use, the structure of animal stock. Systems of keeping pigs in summer and winter. Feeding pigs. The technology of fattening pigs. Sheep breeding. Current state and prospects of development of the sector. The origin of the sheep. Biological and exterior-constitutional features. Economic classification of sheep. Types of sheep productivity. Wool production technology. Sheep wool of different types. Organization of sheep shearing, getting washed wool. Classification of sheepskins and karakul. Breeds of sheep. Keeping and feeding sheep in the stall and grazing periods. Lamb production technology. Horse breeding. Current state and prospects of development of the sector. Milk and meat productivity. Sport horse breeding. Main breeds of horses. Operating capacity and the rational use of horses. Keeping and feeding the horses. Reproduction and breeding technique. Technology of preparation of koumiss.

Practical work №10. Evaluation of cattle by productive features. The study of livestock breeds.

Module 2.4. Basics of veterinary hygiene and veterinary medicine. The concept of veterinary hygiene. General veterinary hygiene requirements for livestock buildings, soil, food and water. Hygiene of animal keeping and management, veterinary hygiene requirements for livestock. The concept of animal health. The set of measures to enhance the protection of farm animals from disease, mortality, to improve veterinary and sanitary conditions of livestock farms, complexes, stud farms. The causes of non-communicable diseases. Measures of prevention of non-communicable diseases. Infectious diseases, their causative agents. Preventive measures of introduction of infection into the economy. Infectious diseases occurring in animals and humans.

A list of labs: Determination of the main types of soils of the zone by monoliths and samples, granulometric composition. Determination of purity, germination, class and sowing suitability of seeds; seeding rate calculation. Determination of major crops by morphological characteristics. Making technology map of vegetable crops cultivation.

List of practical classes: Determination of weeds, pests and diseases by herbaria. Preparation of schemes of crop rotation and rotary tables. Drawing tillage systems for winter and spring crops. Calculation of fertilizers for the planned harvest. Making technology map of pea cultivation. Making technology map of potato cultivation. The study of perennial grasses: morphology and cultivation technology.

Defining features of the skeleton and the system of organs of digestion of animals of different species. Study of nutritional value of feed. Evaluation of cattle by productive features. The study of livestock breeds.

Learning Outcomes	Assessment criteria
Upon successful completion of this module the student:	
LO 2. Owns the basics of agronomy and animal breeding	Has to: 3.1 be able to organize the workplace and own professional vocabulary; 3.2 carry out works under the supervision of specialists of higher qualification; 3.3 know computer methods for data collection, storage and processing; 3.4 be able to work in a team, communicate effectively with colleagues, management, customers;

	<p>3.5 use information and communication technologies to improve the professional activity;</p> <p>3.6 be able to work with reference books and catalogs;</p> <p>3.7 be able to organize own activities, determining the methods and ways to perform professional tasks, assessing their effectiveness and quality;</p> <p>3.8 search, perform analysis and evaluation of the information needed for formulating and solving professional tasks;</p> <p>3.9 monitor the quality of works performed;</p> <p>3.10 know basic agricultural concepts;</p> <p>3.11 know the basics of growing technologies and crop cultivation;</p> <p>3.12 be able to apply tools for basic and special tillage;</p> <p>3.13 apply technological operations in tillage;</p> <p>3.14 own special methods of tillage and techniques of its surface treatment;</p> <p>3.15 perform agronomic requirements for working parts of machines and techniques of basic and surface tillage;</p> <p>3.16 evaluate the level of influence of physical maturity of the soil on the quality of its processing</p> <p>3.17 explain the purpose of the system of tillage for winter and spring crops, the system of pre-sowing, fallow and semi-fallow tillage;</p> <p>3.18 explain the role of fertilizers in improving soil fertility, increasing the quantity and improving the quality of agricultural crops;</p> <p>3.19 distinguish between types of fertilizers according to purpose and properties;</p> <p>3.20 own requirements for mechanical means for fertilizers application;</p> <p>3.21 explain the cost-effectiveness of the science-based use of fertilizers, ensuring the delivery of planned harvests;</p> <p>3.22 have information about using mathematical modeling and computer systems for the development of the system of fertilizers;</p> <p>3.23 comply with the requirements for protection of the environment and quality control of crop products;</p> <p>3.24 calculate doses of fertilizers for the planned harvest;</p> <p>3.25 know design principles of crop farming systems on a regulatory basis;</p> <p>3.26 explain the land reclamation and protection of soil from erosion;</p> <p>3.27 know the technology of cultivation of major crops;</p> <p>3.28 distinguish between biological features of small grains of I and II groups;</p> <p>2.29 explain the economic efficiency of cultivation of small grains;</p> <p>3.30 apply methods of harvesting, drying and storing hay;</p> <p>3.31 distinguish between economic efficiency of cultivation of forage grasses and vegetable crops;</p> <p>3.32 determine the purity, germination and sowing suitability of seeds, calculation of the norms of seeding;</p> <p>3.33 determine major crops by morphological characteristics;</p> <p>3.34 make technological maps of potato, vegetable crops and pea cultivation;</p> <p>3.35 distinguish between forage grasses, perennial grasses and leguminous grasses;</p> <p>3.36 know the basics of feed standardization;</p> <p>3.37 define features of the skeleton and the system of digestion of animals;</p> <p>3.38 distinguish between breeds of agricultural animals and poultry;</p> <p>3.39 know the basics of selective stock breeding;</p> <p>3.40 account and assess the quantity and quality of feed;</p> <p>3.41 use standards for feed;</p> <p>3.42 know the techniques of feed storage;</p>
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	3.43 explain the technology of production of major types of livestock; 3.44 evaluate cattle by productive characteristics; 3.45 distinguish between breeds of farm animals; 3.46 organize the set of measures to enhance the protection of farm animals from disease, mortality, to improve veterinary and sanitary conditions of livestock farms, complexes, stud farms; 3.47 identify the causes of non-communicable and infectious diseases; 3.48 take measures of prevention of non-communicable and infectious diseases; 3.49 take preventive measures of introduction of infection into the economy; 5.50 distinguish between infectious diseases occurring in animals and humans.
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PM 00. Professional modules

PM.01 Maintenance of electric equipment and means of automation

Purpose and task: to create at students system of theoretical and practical knowledge in the field of the electric drive and electric equipment capable to an effective solution of practical tasks of agricultural production and also promoting further development of the personality.

Tasks: to study achievements of science and technology in the field of using the modern electric drives and electric equipment in industries of agricultural production; to learn to calculate the electric drive and to choose electric equipment for machines and installations of agricultural production;

Introduction in the module: to understand value of the electric drive and electric equipment in increase, efficiency of agricultural production; to know technological bases of the electric drive and electric equipment of agricultural production; device, principle of action, main characteristics and methods of the choice of electric equipment; service regulations of electroinstallations; to be able to be guided in principle actions and schemes of the electric drive and electric equipment of agricultural processes: to perform the choice of electric equipment and the automation equipment and to organize their adjustment and operation.

Content of the module: Electric equipment of construction machines and mechanisms: concrete mixers, elevators, vibrators.

Practical occupation No. 1 Calculation of elevators.

Electric equipment and elektrikchesky networks of civil buildings. Protection devices. To choose the device of protection of management of residential and public buildings. Electrorreceivers of residential buildings. Electrorreceivers of the entities of household appointment.

Academic year project: Issue of a task. Characteristic of a subject of designing. Table of basic data. Reasons and choice of system of an electric drive. Calculation of a needed capacity. Choice of electric motor. Choice of automatic machines. Choice of magnetic actuators, thermal relays. Completing of Relay Transformers. Determination of sections of wires and cables. Choice and development of the scheme of management. Electric lighting design. Electric lighting calculation by the Kisp method. Lighting calculation by a dot method. Calculation of lighting lines. Actions for OSH and anti-fire safety. Registration of a graphical part. Execution of the explanatory note.

Learning outcomes upon successful completion of this module the student has to:	Assessment criteria The student has to (verbs: be able, define, choose, estimate, receive, create, carry out, explain, reveal, collect, establish, use, make, prove, etc.)
PO 01. Serve electrical equipment and automation devices Is able to serve electrical equipment and automation devices	1.1. to be able to organize a workplace; 1.2. to own professional lexicon; 1.3 to perform work under the leadership of specialists of higher qualification; 1. 4 to own computer methods of collection, storage and information processing; 1. 5 to be able to work in team, to communicate effectively with colleagues, a management, consumers 1. 6 to use information and communication technologies for enhancement of professional activity; 1. 7 to be able to work with reference books and catalogs; 1.8 to be able to organize own activities, determining methods and methods of accomplishment of professional tasks, estimations their efficiency and quality; 1.9 to perform search, to make the analysis and assessment of information necessary for statement and the solution of professional tasks; 1.10 to show readiness for fixed professional growth, acquisition of new knowledge; 1.11 to own modern information technologies; 1.12 to own skills of creation of electric circuits, using computer programs; 1.13 to manage work of electrotechnical personnel; 1.14 to exercise control for qualities of the performed works; 1.15 to make decisions in standard and unusual situations and to bear their responsibility; 1.16 to own skills of creation of electric circuits, using computer programs; 1.17 to manage work of electrotechnical personnel; 1.18 to use individual and collective remedies from defeat by electric current; 1.19 to use the legal and regulatory base in practice: fire safety regulations, labor protections; safe engineering: types, means, prekduprezhdeniye measures; 1.20 to determine points of short circuit in electric networks; 1.21 to choose the electric drive, electric equipment on execution and a katekgoriya of placement; 1.22 to read schemes of management and system of automation; 1.23 to solve problems on designing; 1.24 to carry out installation of electric equipment; 1.25 to be able to regulate and test electric equipment; 1.26 to fill in documentation on commissioning of the modern electric drive; 1.27 to carry out correctly operation and servicing of the electric drive; 1.28 to apply information technologies and applied programs for a pilot study on electric drive model in various static and transitional modes; 1.29 to choose the switching and protective equipment; 1.30 to arrange results of calculation and the analysis according to requirements of ESKD; 1.31 to carry out calculation of electric loadings of residential and public buildings; 1.32 to carry out the choice of devices of protection and management of residential and public buildings;

	1.33 to explain purpose of electric equipment of cement works; 1.35 to carry out calculation of electric equipment and electric networks of civil buildings; 1.36 to choose the device of protection of management of residential and public buildings; 1.37 to explain purpose of electroreceivers of residential buildings; 1.38 to list electroreceivers of the entities of household appointment; 1.39 to apply the characteristic of an object when designing and to be able to use the table of basic data; 1.40 to carry out reasons for the choice of a system of the electric drive; 1.41 to carry out calculation of needed capacity and a choice of electric drives, automatic machines and magnetic actuators; 1.42 to perform choice of thermal relays; and to be able to carry out completing of Relay Drive; 1.43 to determine sections of wires and cables; 1.44 to carry out the choice and development of the scheme of management; 1.45 to design electric lighting and calculation of electric lighting by the Kisp method; 1.46 to carry out lighting calculation by a dot method and calculation of lighting lines; 1.47 to fulfill requirements for OSH and anti-fire safety; 1.48 to use structure and purpose of uniform system of design documentation/ESCD/; 1.49 to carry out on drawings construction of schemes of electric drives, electric equipments and system of power supply using the software; 1.50 to be able to build drawings of schemes using graphical programs - Autocad, etc.;
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PM.02 Maintenance and supply of electric power to agriculture

Purpose: Forming of system of knowledge and practical skills necessary for the solution of the tasks connected with power supply of rural settlements, buildings and constructions, the entities, farms and country farmsteads.

Tasks: To study the influence of quality of an electrical energy on operation of electroreceivers and action for improvement of indicators of quality of the electric power. Control of indicators of quality of the electric power. Reliability of power supply. Requirements to reliability of power supply of consumers of the first, second and third categories.

Content of the module:

Section 5. Elements of the equipment of high voltage in the systems of power supply.

Testing of isolation of high-voltage electric equipment in electric networks.

Appointment, amount and regulations of testing of isolation of different types of electric equipment. Power supplies and the equipment for isolation testing. Schemes of test facilities.

Laboratory work No. 1. Testing of through passage and basic isolation of the porcelain insulator.

Overstrain internal, atmospheric. Protection against retention.

General information about retention. Internal and atmospheric overstrain. Protection of electric equipment of electric networks against retention. Determination

of step tension.

Types of arresters and the place of their installation on step-down substations, on main administrative, complete transformer substation and distributing devices of high voltage. Rod lightning protection of substations, buildings and constructions. Protection of air-lines cables. Creation of a zone of protection of an object against internal and external retention.

Laboratory work No. 2 Research of a work characteristic of a valve of arrester

Practical occupation No. 1 Calculation of a zone of protection of rod lightning arresters

Course paper planned: In the topic: Power supply of an entity.

Power supply of the civil building and electric equipment of workshop substation.

Composition of the course paper:

A choice and reasons for the diagram of electrical power supply and the set electric equipment for a designed project. Calculation of electrical loadings on the sides of 0,4 and 6-10 kV. Calculation of lighting loadings for power density. A reactive power compensation on the sides of 0,4 and 6-10 kV. A choice of power transformers (technical and economic comparing of scheduled options isn't required). Calculation of short-circuit currents on buses of 6-10 kV of substation (station) of the plant from which buses of the designed project receive supply. Input cable choice. Calculation of short-circuit currents on the side of 6-10 kV of shop RU. Calculation of short-circuit currents on buses of 0,4 kV of shop substation. A choice of a protective switching equipment and conduction production on 0,4 kV;

Choice and check of the high-voltage equipment. Choice of combined buses 0,4kvi6-10kv.

12. Choice of measuring transformers of current and tension

13. Calculation of relay protection. Calculation of the grounding device and shop substation.

Learning outcomes	Assessment criteria
upon successful completion of the module "Maintenance of electric equipment and means of automation" the student:	
PO 2 Is able to maintain and supply electric power in the agriculture	has to: 2.1. to be able to organize a workplace; 2.2. to master professional lexicon; 2.3 to perform work under the leadership of specialists of higher qualification; 2. 4 to master computer methods of collection, storage and information processing; 2. 5 to be able to work in team, to communicate effectively with colleagues, a management, consumers 2. 6 to use information and communication technologies for enhancement of professional activity; 2.7 to be able to organize own activities, determining methods and methods of accomplishment of professional tasks, estimations their efficiency and quality; 2.8 to perform search, to make the analysis and assessment of information necessary for statement and the solution of professional tasks; 2.9 to show readiness for fixed professional growth, acquisition of new knowledge;

	<p>2.10 to master skills of creation of electric circuits, using computer programs;</p> <p>2.11 to manage work of electrotechnical personnel;</p> <p>2.12 to exercise control for qualities of the performed works;</p> <p>2.13 to make decisions in standard and unusual situations and to bear their responsibility;</p> <p>2.14 to own skills of creation of electric circuits, using computer programs;;</p> <p>2.15 to manage work of electrotechnical personnel;</p> <p>2.16 to apply regulations of testing of isolation of different types of electric equipment;</p> <p>2.17 to use power supplies and the equipment for isolation testing;</p> <p>2.18 to read schemes of test facilities and to carry out testing of check-point and basic isolation of the porcelain insulator;</p> <p>2.19 to differentiate internal and atmospheric overstrain and be able to define the step voltage;</p> <p>3.20 to apply protection of electric equipment of electric networks against retention;</p> <p>2.20 to differentiate types of arresters and the place of their installation on step-down substations, on main administrative, complete transformer substation and distributing devices of high voltage;</p> <p>2.21 to use rod lightning protection of substations, buildings and constructions;</p> <p>2.22 to carry out protection of air-lines cables and construction of a zone of facility protection from internal and external overloadings;</p> <p>2.23 to research a work characteristic of a valve arrester and to execute calculation of a zone of protection of rod lightning arresters;</p> <p>2.24 to read a scheme of the general layout of agricultural enterprise with data on shops (P- the number of receivers in the shop; $P_{min} \cdot P_{max}$ - capacity of the greatest and smallest receivers in the shop; P_{set} - an installed capacity of the shop the weighted average power factor of the shop; K_i - shop utilization rate);</p> <p>2.25to be able to use the table with the passport data on receivers established in the shop with indication of the name and passport data of each receiver;</p> <p>2.26 to be able to use the table on the receivers established in the shop with indication of the name and passport data of each receiver;</p> <p>2.27 to possess information on electrical power supply of the civil building and an electric equipment of tsekhokvy substation;</p> <p>2.28 to execute a choice and reasons for the diagram of electrical power supply and the set electric equipment for a designed project;</p> <p>2.29 to execute calculation of electrical loadings on the sides of 0,4 and 6-10 kV and to execute calculation of lighting loadings for specific power density;</p> <p>2.30 to define a reactive power compensation on the sides 0,4 and 6-10 kV;</p> <p>2.31 to execute a choice of power transformers and the input cable;</p> <p>2.32to execute calculation of short-circuit currents on buses of 6-10 kV of substation (station) of the plant from which buses the designed project receives a supply;</p> <p>2.33 to execute a calculation of short-circuit currents on the side of 6-10 kV of shop RU and on buses 0,4 kV of shop substation;</p> <p>2.34to execute a choice of a protective switching equipment and conduction production on 0,4 kV;</p> <p>2.35 to be able to justify values of coefficients: K_V; K_{lv}; K_p; K_z</p>
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	(the temperature, considering receiver operation mode, number of conductors and whether the network of protection against an overload requires); 2.36 to execute a choice of the automatic machine of input and section automat; 2.37 to execute a choice of a protective equipment and conduction production to one engine and to one node; 2.38 to make the pivot table on a protective switching equipment and conduction production; 2.39 to execute a choice and check of the high-voltage equipment, measuring transformers of current and voltage; 2.40 to execute calculations of relay protection and the grounding device and shop substation; 2.41 to make a choice of combined buses 0,4 and 6 -10kV to draw the unilinear estimated diagram of a force network of the civil building; 2.42 to specify in the general layout of the enterprise the schemes of electrical power supply of the civil building with a loading cartogram;
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PM. 03 Automation and mechanization of production processes

Purpose and task: to teach future technicians - electricians it is correct and rational to use the machines entrusted to them and the equipment which are used in agricultural production

Content of the module:

Electric equipment of tractors and cars. Electric equipment of tractors and cars.

Current sources. Battery system of ignition of the engine. System of electric launch of the engine. Starters, generators, appointment, device, work.

Laboratory work № 1. Determination of defects in system of ignition of the engine. Servicing of rechargeable batteries.

Studying and determination of defects in operation of the generator, P 362-B relay regulator, a starter.

Independent works

Creation and description of the scheme of system of ignition of the engine

Automation and mechanization of production processes in crop production. Mechanization of engineering procedures of the soil handling. Classification of tillage machines and tools.

Practical training No. 1. Studying of working bodies of plows, cultivators and harrows.

Independent work. Description of work of rotary plows for the main handling of the soil.

Mechanization of engineering procedures of cleaning of grain and leguminous crops. Methods and engineering procedures of cleaning of grain crops. System of machines. Main adjustments, maintenance, quality control.

Independent work. Creation of the scheme of automatic control of import combines.

Mechanization of engineering procedures of postharvest handling of grain.

Classification zernoochistitelykh of machines. Device and working process zernoochistitelykh of machines. Device and working process grain dryers.

Drying of agricultural products. A concept about drying, its value. Artificial drying. Mechanism and kinematics of process of drying. Classification of drying aggregates.

Independent work Creation of the scheme of artificial aeration of hay.

Mechanization of engineering procedures in livestock production. Automation and mechanization of creation and maintenance of a microclimate in livestock rooms. General information about livestock farms and complexes.

Classification and layout of farms. Buildings and constructions. A concept about a microclimate. A microclimate in livestock rooms. Creation of required parameters of a microclimate. Technical means for creation of a microclimate.

Independent work Description of technology of heating of pigs.

Mechanization of water supply of livestock farms and pastures. Need for water and its quality. Water supply sources. Water hoist engines and installations. Water supply of pastures. Equipment of water intaking constructions. Types of pumps. Device and service regulations.

Practical training No. 2. A research of the tower and crackheaded water supplying installations.

Independent work Creation of the scheme of water supply and a poyeniye of animals on a farm.

Automation and mechanization of preparation, loading and distribution of forages.

Equipment for preparation of liquid forages. Loaders of forages. Mobile and stationary distributors of forages. Classification of forages. Cars for cleaning, sorting and a sink of forages. Cars for crushing of forages their device, working process and adjustment. Cars for thermal treatment of forages, classification, a design and the principle of work. Units for preparation of the combined forages. Equipment for preparation of liquid forages. Loaders of forages. Mobile and stationary distributors of forages.

Automation and mechanization of milking of cows and preprocessing of milk. Bases of machine milking. Milking machines, principle of action. Milking machines, their classification, technological process, device and adjustment. Equipment for milk preprocessing. Coolers, separators, pasteurizers. Milk cleaner cooler.

Practical training No. 3. Studying of operation of milking machines

Independent work the Description of the small-sized equipment used on small livestock farms.

Automation and mechanization of cleaning and processing of manure. Technological processes of cleaning of manure and dung. Mechanical means of removal of manure. Hydroremoval, utilization and storage of manure. Processing of manure and dung. Modern methods of utilization and processing of manure and dung. Biotechnologies in processing processes.

Practical training № 4. Choice of technology of cleaning and utilization of manure.

Learning outcomes	Assessment criteria
Upon successful completion of this module “Automation and mechanization of production processes the student:	The student has to: 3.1. to be able to organize a workplace; 3.2. to master professional lexicon and be able to work with a reference literature and catalogues; 3.3 to perform work under the leadership of specialists of higher qualification;

<p>PO 03 is able to maintain the automated and mechanised production processes. Is able to serve automated and mechanized processes of production</p>	<p>3. 4 to master computer methods of collection, storage and information processing; 3. 5 to be able to work in team, to communicate effectively with colleagues, a management, consumers 3. 6 to use information and communication technologies for professional activity; 3.7 to be able to organize own activities, determining methods and methods of accomplishment of professional tasks, estimations their efficiency and quality; 3.8 to perform search, to make the analysis and assessment of information necessary for statement and the solution of professional tasks; 3.9 to show readiness for fixed professional growth, acquisition of new knowledge; 3.10 to master skills of creation of electric circuits, using computer programs; 3.11 to manage work of electrotechnical personnel and exercise control for quality of the works; 3.12 to make decisions in standard and unusual situations and to bear responsibility; 3.13 to own skills of creation of electric circuits, using computer programs; 3.14 to apply classification of engines to destination, to the principle of work, a method of implementation of a job cycle, a type of the applied fuel, number and an arrangement of cylinders, but type of chilling and a method of ignition of gas mixture; 3.15 to prepare rechargeable batteries for operation, to check technical condition of the main mechanisms of electric equipment of tractors and cars; 3.16 to sort, collect and regulate the mechanism of the back bridge of the tractor (car); 3.17 to mount automobile wheels and to pull tractor caterpillars; 3.18 to check and regulate steering; 3.19 to determine and eliminate defects of hydraulic hinged system traktora4 3.20 to hang the hinged working machine on the tractor; 3.21 to regulate controlling mechanism of mechanization of engineering procedures of handling of the soil; 3.22 to apply methods and means of mechanization of engineering procedures of crops and landing of crops; 3.23 to carry out dismantling, assembly, adjustment and preparation for operation of pumps and autodrinking bowls; 3.24 to sort, collect, to regulate and prepare for operation of the machine, the equipment and aggregates for preparation and distribution of forages; 3.25 to dismantle, to assemble, to regulate and prepare the milking machine for work; 3.26 to carry out calculation of a microclimate of livestock farms; 3.27 to carry out repair of the machine for handling the distribution of forages and milking machines; 3.28 to carry out repair the dunhill-cleaning transporters; 3.29 to constitute schemes of water supply and a supply of water for animals's drinking on a farm; 3.30 to master a system of mechanization and maintenance of a microclimate in livestock rooms; 3.31 to apply the methods of calculation of reliability of systems of automation in the village x.;</p>
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	3.32 to serve system automation of engineering procedures of storages of agricultural products; 3.33 to serve a system of automation of engineering procedures in a forage production; 3.34 to serve a system of automation of water supply and irrigation; 3.35 to serve a system of automation of engineering procedures in poultry farming; 3.36 to explain the importance of technical and economic efficiency of automation of engineering procedures; 3.37 to apply regulating documents on automation of production processes; 3.38 to apply conditional graphic symbols of automation elements; 3.39 to research stability of system of automatic equipment; 3.40 to carry out choice of regulator and calculation of setup of parameters of the regulator; 3.41 to determine efficiency of automation of production processes in agricultural industry; 3.42 to set up sensors and regulators of temperature and logical elements of automatic equipment; 3.43 to customize two-position and three-position systems of automatic control; 3.44 to carry out development of the function chart of automatic system; 3.45 to carry out the choice of elements of automatic system; 3.46 to develop algorithmic schemes; 3.47 to define stability of automatic system; 3.48 to carry out the choice of the correcting link and calculation of settings of the regulator; 3.49 to carry out creation of the schedule of transition process and definition of indicators of quality; 3.50 to prove and execute the choice of technical means for automation.
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PM.04 Mounting, maintenance and repair of electric facilities

Purpose and task: acquisition by students a type of professional activity and the appropriate professional competences of necessary skills on mounting and operation of an electric equipment of an agricultural electric equipment.

Content of the module:

Section 1. Mounting bases.

Module 1. General questions of mounting of an electric equipment. Normative documents and departmental mounting instructions of an electric equipment. Main normative documents, technical, mounting, constructional documentation.

Section 2. Mounting of electroconductings.

Module 2.1 Preparation of routes of electroconductings. Marking, shorting, fixing operations.

Installation wires, cable products, conduction materials and products. Electromounting and installation wires. Laboratory work #1. Connection of wires' cores and cables.

Module 2.2 Mounting of electroconductings. Mounting of open conductings. A spacer of electroconductings on strings, in trays, in pipes. Mounting of the buried wirings. Requirements to the buried wiring. Technological operation of mounting

of the buried wiring. Mounting of outside conductings. Mounting of conductings in boxes and in trays

Laboratory work No. 2 Mounting of conductings in production locations

Practical work No. 1 Calculation of a lighting network for current, loading and losses of tension

Section 3. Mounting of electromotors. Mounting of electromotors. Three-phase asynchronous electromotors of an alternating current. Construction, marking, types. Lead identification of windings of EM, classification of EM, main types ASYNCHRONIC ENGINE. Storage, loading, transportation ASYNCHRONIC ENGINE. Execution of the reference bases. The reference bases, their execution, check of the base under mounting. Adjustment of shaft of electromotors, solidifying of foundation bolts

Laboratory work No. 2 Mounting of electromotors

Section 4. Mounting of an equipment of control and protective equipment of automation.

Mounting of an equipment of control and protective equipment of automation. Non-automatic and automatic equipment of control. Breakers, the universal switches, relay, actuators. Diagrams of switching on. Mounting of an equipment of control and protection. Fuses, thermal relay, time cut-outs. Stations of control.

Laboratory work No. 3 Mounting of the automation equipment

Practical training № 4. Calculation and choice of security features and brands of wires

Section 5. Mounting of devices of grounding and nulling. Mounting of devices of grounding and nulling. Mounting of the grounding, zero protective conductors. Requirements to mounting, main data. Requirement of PUE to grounding of electric sets. Materials for grounding. Technology of mounting of devices of grounding.

Practical work No. 2 Calculation of the grounding device of a production object

Section 6. Mounting of heating installations. Mounting of heating installations. The device and diagrams of switching on of electric sets for heating of air, water, steam. Electric fans and electrocalorifer installations, installations for soil heating.

Laboratory work № 5. Mounting of electric heating installations

Section 7. Mounting of the lighting and irradiating installations. Mounting of lamps. Mounting start regulating devices. Requirements to PRA, classification of PRA, failure. Features of the device and mounting of lighting installations in home and auxiliary locations. Preparatory work, mounting of lamps. Nulling and grounding by a starr-earthed and isolated neutral

Practical task # 6 Calculation and choice of lamps

Laboratory work # 7 Mounting of lamps.

Learning outcomes	Assessment criteria
Upon successful completion of this module “Mounting and maintenance of electric facilities and automated systems” PO. 04 the student is able to	has to: 4.1. to be able to organize a workplace; 4.2. to own professional lexicon and work with a reference literature and catalogues; 4.3 to perform work under the leadership of specialists of higher qualification; 4. 4 to own computer methods of collection, storage and information

<p>execute a mounting and maintenance of electric facilities and automated systems</p> <p>Is able to perform mounting, maintenance and repair of electric facilities</p>	<p>processing;</p> <p>4. 5 to be able to work in team, to communicate effectively with colleagues, a management, consumers</p> <p>4. 6 to use information and communication technologies for enhancement of professional activity;</p> <p>4.7 to be able to organize own activities, determining methods and methods of accomplishment of professional tasks, estimations of their efficiency and quality;</p> <p>4.8 to perform search, to make the analysis and assessment of information necessary for statement and the solution of professional tasks;</p> <p>4.9 to show readiness for fixed professional growth, acquisition of new knowledge;</p> <p>4.10 to own modern information technologies;</p> <p>4.11 to own skills of creation of electric circuits, using computer programs;</p> <p>4.12 to manage work of electrotechnical personnel;</p> <p>4.13 to exercise control for qualities of the performed works;</p> <p>4.14 to make decisions in standard and unusual situations and to bear responsibility;</p> <p>4.15 to own skills of creation of electric circuits, using computer programs;</p> <p>4.16 to use individual and collective remedies from defeat by electric current;</p> <p>4.17 to use the legal and regulatory base in practice: fire safety regulations, labor protections; safe engineering: types, means, preventive measures;</p> <p>4.18 to use metalwork and replacement tools to destination, to the principle of action, feature of devices, criteria of a choice, rules of safe operation;</p> <p>4.19 to determine the types of production traumatism and morbidity;</p> <p>4.20 to carry out actions for occupational health and safety;</p> <p>4.21 to determine the factors influencing working conditions;</p> <p>4.22 to own general questions of installation of electric equipment;</p> <p>4.23 to apply regulating documents and departmental instructions for installation of electric equipment;</p> <p>4.26 to apply the main regulating documents, technical, assembly, constructional documentation;</p> <p>4.27 to carry out preparation: routes of electropostings, razmetochny, penetrative, fixing works, adjusting wires, cable product, conduction materials and products, electroassembly and adjusting wires;</p> <p>4.24 to carry out connection of veins of wires and cables and to carry out laying of electropostings on strings, in trays, in pipes;;</p> <p>4.25 to carry out installation of the open and blind entries, installation of external postings and postings in boxes and in trays;</p> <p>4.26 to fulfill requirements to the blind entry;</p> <p>4.27 to execute technological operation of mounting of the buried wiring and to execute calculation of a lighting network for current, loading and losses of tension;</p> <p>4.28 to execute mounting of electromotors;</p> <p>4.29 to apply lead identifications of windings of EM, classification of EM, the main types of Asynchronous Engine;</p> <p>4.30 to execute check of the base under mounting, adjustment of shaft of electromotors, solidifying of foundation bolts;</p>
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	4.31 to use the appropriate tool to adjustment; 4.32 to execute mounting of an equipment of control and protective equipment of automation, equipments of control and protective equipment of automation, non-automatic and automatic equipment of control, breaker, the universal switch, relay, actuators, fuses, time cut-out; 4.33 to read diagrams of switching on; 4.34 to execute mounting of the automation equipment; 4.35 to execute calculation and a choice of security features and brands of wires; 4.36 to execute mounting of devices of grounding and the nulling grounding zero protective conductors; 4.37 to fulfill requirements to mounting, requirements of PUE to grounding of electric sets; 4.38 to execute calculation of the grounding device of a production object; 4.39 to execute mounting of heating installations, devices of switching on of electric sets for heating of air, water, steam, electroventilatory and electrocalorifer installations, installations for soil heating; 4.40 to execute mounting of the lighting and irradiating installations, lamps, the start regulating devices; 4.41 to fulfill requirements to PRA, classification of PRA, failure; 4.42 to explain features of the device and mounting of lighting installations in home and auxiliary locations; 4.43 to execute calculation and choice, mounting of lamps; 4.44 to execute mounting of nulling and grounding by a starr-earthed and isolated neutral
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Applied bachelor Qualification – “Junior engineer-electrician”

OPM.00 General professional modules

BOM.01. Non-traditional sources of electric energy

Purpose: assimilation of knowledge of types of resources of the nonconventional renewable energy resources (NRER), acquisition of skills by determination of potential of main types of NRER.

Tasks: knowledge of main types of NRER of sources of their power potential, the main types of power stations based on NRER, their main energy, economic and ecological characteristics;

Content of the module: Condition and prospects of development of alternative energy sources. Traditional and unconventional sources of energy. Inventories and dynamics of consumption of energy resources, the politician of RK in the field of nonconventional and renewable energy resources. Main objects of nonconventional power of RK.

Transformation of a solar energy into electric. Intensity of sunlight. Photo-electric p-n properties of transition. Volt-ampere characteristic of a solar element. Designs and materials of solar elements. Systems of solar heat supply. Classification and basic elements of heliosystems. The concentrating helioreceivers. Flat solar collectors.

Thermal accumulation of energy. Energy balance of the thermal accumulator. Classification of accumulators of heat. Systems of accumulation. Thermal

accumulation for solar heating and chilling of rooms.

Wind energy and possibilities of its use. Wind origin, wind zones RK. Classification of wind turbines by the principle of work. Work of a surface in case of action of wind force on it. Work of a wind wheel of a vane wind turbine. Theory of the ideal wind-driven generator. Concept of the ideal wind-driven generator. Classical theory of the ideal wind-driven generator. Theory of the real wind-driven generator. Operation of elementary blades of a vetrokoles. First equation of communication. Second equation of communication. Moment and capacity of all wind-driven generator. Losses of wind turbines.

Thermal mode of crust. Sources of geothermal heat. Thermal mode of crust. Underground thermal waters (hydroterms). Inventories and distribution of thermal waters. A condition of geothermal power in RK.

Use of a geothermal power for development of a heat and electrical energy. Direct use of a geothermal power. Geothermal power plants with a binary cycle.

Use of a geothermal power for heat supply of residential and production buildings. Heat supply the high-temperature strongly mineralized thermal water. Heat supply the low-temperature low-mineralized thermal water. Energy resources of the ocean. Balance of renewable energy of the ocean. Bases of transformation of the waves' energy. Converters of energy of waves: the waves tracking a wave profile using energy of the fluctuating water column, underwater devices. Use of energy of the inflows and sea currents. General information about energy use of inflows. Capacity of tidal currents and tidal rising of water. Energy use of ocean currents. General characteristic of technical solutions. Concept and classification of biofuel. Biofuel. Biofuel classification. Structure and properties of excrement of animals and birds. A biogas exit from agricultural waste. A source of raw materials for biogas production.

Use of biofuel for the energy purposes. Production of biomass for the energy purposes. Pyrolysis (dry distillation). Thermochemical processes. Spirit fermentation (fermentation).

Biofuel stations. Bioreactor. Preparation and a raw material feed in the bioreactor. Maintenance of fixed temperature in the bioreactor. System of hashing of raw materials in the bioreactor. Storage system and uses of biogas.

Environmental problems of use of alternative energy sources. Problem of interaction of power and ecology. Ecological consequences of development of solar power. Influence of wind power on the environment. Possible ecological manifestations of geothermal power. Ecological consequences of energy use of the ocean. Ecological characteristic of use of biopower stations. Ecological characteristic of use of biopower stations.

Subjects of a practical training:

Calculation of systems of solar heat supply.

Calculation of wind power installations.

Calculation of systems of geothermal heat supply.

Calculation of the OTES parameters.

Calculation of biopower stations.

Subjects of laboratory works:

Research of characteristics of the battery of solar photo cells. Hydraulic testing of a flat solar collector. Research of work of wind power installation. Research of operation of the heatexchange device.

Preparation for lectures, laboratory and practical training.

Independent study of the discipline topics

Chilling of air and desalination of water by means of a solar energy.

Solar ponds. Biological, chemical and mechanical accumulation of energy.

Production of mechanical work with the wind energy help. Wind farms in structure energosity.

Double-circuit geothermal power plants.

Glacial power plants.

Strengthening of inflows.

Hydroheat-sink stations.

Photosynthesis.

Subjects of calculation works

Calculation of long-term characteristics of systems of solar heat supply.

Calculation of characteristics of wind power installations.

Calculation of parameters of ocean thermal power plant.

Learning outcomes	Assessment criteria The student (verbs: be able, define, choose, estimate, receive, create, carry out, explain, reveal, collect, establish, use, make, prove, etc.)
Upon successful completion of the module “Non-traditional sources of energy in agriculture PO 01 the student is able to apply non-traditional sources of electric energy in agriculture	has to: 1. 1. to be able to organize a workplace; 1.2. to master professional lexicon and be able to work with a reference literature and catalogues; 1.3 to master computer methods of collection, storage and information processing; 1. 4 to be able to work in team, to communicate effectively with colleagues, a management, consumers 1. 5 to use information and communication technologies for enhancement of professional activity; 1.6 to make decisions in standard and unusual situations and to bear their responsibility; 1.7 to be able to organize own activities, determining methods and methods of accomplishment of professional tasks, estimations their efficiency and quality; 1.8 to perform search, to make the analysis and assessment of information necessary for statement and the solution of professional tasks; 1.9 to show readiness for fixed professional growth, acquisition of new knowledge; 1.10 to master modern information technologies; 1.11 to exercise control of quality of the performed works; 1.12 to apply the regulatory legal acts governing the relations in agricultural industry; 1.13 to master sufficient preparation for acquisition of knowledge in the field of advanced technologies; 1.14 to be able to create conditions for advanced training of personnel; 1.15 to make an experiment by the set techniques with handling and the analysis of results;

	<p>1.16 to be able to plan work of personnel;</p> <p>1.17 to carry out the organization for creation or reorganization of production sites;</p> <p>1.18 to solve problems, to estimate risks and to make decisions in unusual situations;</p> <p>1.19 to be able to set the purpose, to motivate activities of subordinates;</p> <p>1.20 to organize and control work of personnel with acceptance on itself responsibility for result of task performance;</p> <p>1.21 to be able to generate ways of improvement of technical indicators of quality of management of electrical power installations;</p> <p>1.22 to estimate service quality of power stations and automatic control;</p> <p>1.23 to master skills of creation of electric circuits, using computer programs;</p> <p>1.24 to differentiate traditional and unconventional sources of energy;</p> <p>1.25 to determine dynamics of consumption of energy resources of Kazakhstan in the field of nonconventional and renewable energy resources;</p> <p>1.26 to possess information on the main objects of nonconventional power industry of Kazakhstan;</p> <p>1.27 to explain a concept intensity of sunlight;</p> <p>1.28 to apply the phenomenon of photo-electric p-n property of transition;</p> <p>1.29 to apply methods of transformation of a solar energy to electric;</p> <p>1.30 to be able to build the volt-ampere characteristic of a solar element;</p> <p>1.31 to explain designs and materials of solar elements;</p> <p>1.32 to apply classification and basic elements of heliosystems;</p> <p>1.33 to explain purpose of the concentrating helioreceivers, flat solar collectors;</p> <p>1.34 to explain essence of thermal accumulation for solar heating and chilling of rooms;</p> <p>1.35 to look for possibilities of energy use of wind;</p> <p>1.36 to own the theory of the classical and real wind-driven generator;</p> <p>1.37 to possess information on the thermal mode of crust, on geothermal power plants with a binary cycle, about energy resources of the ocean;</p> <p>1.38 to explain the Concept and classification of biofuel;</p> <p>1.39 to be able to apply raw base to biogas production;</p> <p>1.40 to explain purpose of biopower stations, the bioreactor;</p> <p>1.41 to represent system of hashing of raw materials in the bioreactor, a storage system and uses of biogas;</p> <p>1.42 to possess information on environmental problems of use of alternative energy sources;</p> <p>1.43 to carry out calculation of systems of solar heat supply;</p> <p>1.44 to carry out calculation of wind power installations;</p> <p>1.45 to carry out calculation of systems of geothermal heat supply;</p> <p>1.46 to carry out calculation of the OTES parameters;</p> <p>1.47 to carry out calculation of biopower stations;</p> <p>1.48 to research characteristics of the battery of solar photo cells;</p> <p>1.49 to carry out hydraulic testing of a flat solar collector;</p> <p>1.50 to conduct a research of work of wind power installation;</p> <p>1.51 to conduct a research of operation of the heatexchange device;</p> <p>1.52 to carry out calculation of long-term characteristics of systems of solar heat supply;</p> <p>1.53 to carry out calculation of characteristics of wind power installations;</p> <p>1.54 to carry out calculation of parameters of ocean thermal power plant.</p>
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BGM.02 Software in solution of mathematical tasks in electric energy sector

Purpose: to connect mathematics as a general-theoretical rate with practical applications in work of the specialist in the field of power industry and to give a specific mathematical apparatus for applied researches.

Module tasks: advance training of students for perception of mathematical questions in special rates and to conscious application of mathematics in case of the solution of various electrical power tasks, studying of methods and acceptances of their decision by means of which receive reliable results and most of which quickly conduct to the purpose.

Content of the module: mathematical tasks in power industry. The tasks arising during the designing and operation of electrical power systems. Analytical representation of a configuration of electric networks and their decision using laws of Ohm and Kirchhoff in a matrix form. Mathematical bases of optimization of parameters and modes of electrical power systems. Characteristic optimization tasks: management of the normal set modes of power supply systems, planning and development of electrical power systems on different temporary prospect, etc.

Application of methods of mathematical programming in power industry. Linear programming in relation to practical tasks of power industry. Formulation of a task of linear programming. Concept of exact and approximate methods of the solution of the linear algebraic equations. Creation of economic-mathematical models of tasks of linear programming. Simplex method of the decision. Graphical method of the solution of tasks of linear programming. Representation of the return matrixes in the form of the work of double factors. The theory of duality in linear programming. Theory of directed and not directed counts.

Scopes and main acceptances of the decision. Statement of a transport task in the field of power industry. Creation of mathematical model of a transport task. Methods of finding of initial basic plans. Verification of the solution of a transport task by method of potentials. The solution of open transport tasks and transport tasks with intermediate transportations. Transport tasks in network statement with use of a method of borders and branches.

Nonlinear programming. Problem definition of nonlinear programming in the field of power industry. Application of a method of uncertain multipliers of Lagrange in electrical power tasks. Kuhn-Takker's theorem. Gradient optimization methods.

Dynamic programming. A concept of dynamic programming and examples of problem definitions of dynamic programming in the field of power industry. Geometrical interpretation of typical tasks of dynamic programming in power industry. Principle of step-by-step creation of optimum control. Method of the functional equations.

Criteria programming. Research of technical and economic models of power generation facilities (power line, transformer substations, etc.). Determination of criteria of similarity. Harmony research. Determination of parameter values and costs in a point of a minimum of criterion function. Research of technical and economic stability. Concepts about stability in "small" and "big". Concepts of static and dynamic stability. Algebraic criteria of stability. Repeated optimization of sensitivity of parameters and costs in a minimum point to change of data. Method of consecutive intervals. Application of a method of Lyapunov in case of the solution

of electrical power tasks.

Application of probability theory and mathematical statistics in electrical power tasks. Accidental phenomena and events. Random variables. Mathematical models of refusals and recoveries. Collection of statistical data on refusals and recoveries. Determination of the distribution laws of random variables and their numerical characteristics. Criteria of a consent. Measure definition of reliability of various schemes of electrical power systems, time of their recovery or not recovery and probability of their refusal. Theory of stochastic functions. Monte Carlo method.

Approximate list of a practical training:

Creation of mathematical models by means of systems of the linear equations. The address of matrixes and creation of the modified Jordan tables. Creation of mathematical models of the equations of the set modes with use of matrix methods. Calculations of the set modes of electrical power systems with a help of the RASTR Program and its applications.

Creation of mathematical model of a transport task and its decision in a matrix form using the personal computer Creation of mathematical model and the solution of a transport task with intermediate transportations.

Dynamic programming. Principle of an optimality of Bellman. Creation of mathematical model on the basis of a method of uncertain multipliers of Lagrange. Determination economically and technically the reasonable level of loading of the transformer substations feeding one industrial enterprise.

Mathematical modeling in power supply tasks. Creation of mathematical models of the transformer and electric motor. Mathematical modeling of the processes proceeding in transformers in case of various modes of their work.

Mathematical modeling in power supply tasks.

Creation of mathematical models of the transformer and electric motor. Mathematical modeling of the processes proceeding in transformers in case of various modes of their work.

Mathematical modeling of the electric motor. Synthesis of systems avtoreguliropochnmkh of electrical wires. Model of the closed SAU.

Approximate list of the tasks topics for independent work:

The solution of tasks with use of matrix methods. Determination of currents in branches and tension in nodes of projectible electrical power system. Verification of the received decisions by means of personal computer.

Mathematical simulation in tasks of non-linear programming. Application of a method of indefinite multipliers

Lagrange for determination of optimum reactive power of the synchronous motors in case of the solution of a question of a reactive power compensation.

Application of probability theory in electrical power tasks. Measure definition of reliability of electrical power systems. Calculation of external and spatial harmonics of electrical machines.

Calculation of electromechanical transient phenomena in electric drives.

Learning outcomes	Assessment criteria
<p>Upon successful completion of this module PO 02 the student is able to apply the software in decision of mathematical tasks in power industry is able to solve mathematical problems in power industry applying software simulation</p>	<p>Has to:</p> <ol style="list-style-type: none"> 2. 1. to be able to organize a workplace; 2.2. to own professional lexicon; 2.3 to perform work under the leadership of specialists of higher qualification; 2. 4 to own computer methods of collection, storage and information processing; 2. 5 to be able to work in team, to communicate effectively with colleagues, a management, consumers 2. 6 to use information and communication technologies for enhancement of professional activity; 2. 7 to be able to work with reference books and catalogs; 2.8 to make decisions in standard and unusual situations and to bear their responsibility; 2.9 to be able to organize own activities, determining methods and methods of accomplishment of professional tasks, estimations their efficiency and quality; 2.10 to perform search, to make the analysis and assessment of information necessary for statement and the solution of professional tasks; 2.11 to show readiness for fixed professional growth, acquisition of new knowledge; 2.12 to master modern information technologies; 2.13 to exercise control of quality of the performed works; 2.14 to apply the regulatory legal acts governing the relations in agricultural industry; 2.15 to master sufficient preparation for acquisition of knowledge in the field of advanced technologies; 2.16 to be able to create conditions for advanced training of personnel; 2.17 to make an experiment by the set techniques with handling and the analysis of results; 2.18 to be able to plan work of personnel; 2.19 to carry out the organization for creation or reorganization of production sites; 2.20 to solve problems, to estimate risks and to make decisions in unusual situations; 2.21 to be able to set the purpose, to motivate activities of subordinates; 2.22 to organize and control work of personnel with acceptance on itself responsibility for result of task performance; 2.23 to be able to provide analytically configurations of electric networks and their decision using laws of Ohm and Kirchhoff in a matrix form. 2.24 to apply mathematical bases of optimization of parameters and the modes of electrical power systems; 2.25 to solve characteristic optimization problems: management of the normal set modes of power supply systems, planning and development of electrical power systems on different temporary prospect, etc.; 2.26 to apply methods of mathematical programming in power industry; 2.27 to apply linear programming to practical tasks of power industry; 2.28 to constitute economic-mathematical models of tasks of linear programming; 2.39 2.39 to apply a simplex method of the solution of tasks; 2.29 to apply a graphical method of the solution of tasks of linear programming; 2.30 to present the return matrixes in the form of the work of double factors;

	<p>2.31 to apply the theory of duality in linear programming;</p> <p>2.32 to apply the theory of directed and not directed counts;</p> <p>2.33 to constitute mathematical models of a transport task;</p> <p>2.34 to master methods of finding of initial basic plans and verifications of the solution of a transport task by method of potentials;</p> <p>2.35 to solve open transport problems and transport tasks with intermediate transportations, transport tasks in network statement with use of a method of borders and branches;</p> <p>2.36 to apply nonlinear programming;</p> <p>2.37 to carry out problem definition of nonlinear programming in the field of power industry;</p> <p>2.38 to apply a method of uncertain multipliers of Lagrange in electrical power tasks, Kuhn-Takker's theorem, a gradient optimization method;</p> <p>2.39 to apply geometrical interpretation of typical tasks of dynamic programming in power industry;</p> <p>2.40 to own the principles of step-by-step creation of optimum control and method of the functional equations;</p> <p>2.41 to research technical and economic models of power generation facilities (the power line, transformer substations, etc.);</p> <p>2.42 to determine criteria of similarity;</p> <p>2.43 to research harmonics;</p> <p>2.44 to determine a parameter value and costs in a point of a minimum of criterion function;</p> <p>2.45 to research technical and economic stability;</p> <p>2.46 to apply a method of consecutive intervals, Lyapunov in case of the solution of electrical power tasks;</p> <p>2.47 to apply probability theory and mathematical statistics in electrical power tasks;</p> <p>2.48 to determine the distribution laws of random variables and their numerical characteristics;</p> <p>2.49 to determine indicators of reliability of various schemes of electrical power systems, time of their recovery or not recovery and probability of their refusal, the theory of stochastic functions, a Monte Carlo method;</p> <p>2.50 to carry out calculations of the set modes of electrical power systems with the help of the RASTR program and its applications;</p> <p>2.51 to constitute mathematical model of a transport task and to solve it in a matrix form using the personal computer;</p> <p>2.52 to constitute mathematical model and to solve a transport problem with intermediate transportations;</p> <p>2.53 to constitute mathematical model on the basis of a method of uncertain multipliers of Lagrange;</p> <p>2.54 to determine economically and technically reasonable levels of loading of the transformer substations feeding one industrial enterprise;</p> <p>2.55 to constitute mathematical models of the transformer and electric motor;</p> <p>2.56 to execute mathematical modeling of the processes proceeding in transformers in case of various modes of their work;</p> <p>2.57 to solve problems with use of matrix methods;</p> <p>2.58 to determine currents in branches and tension in nodes of projectible electrical power system;</p> <p>2.59 to solve problems of linear programming by a graphic approach using the personal computer;</p>
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	2.60 to solve problems on dynamic programming, an algorithm of finding of the shortest way; 2.61 to carry out calculation of external and spatial harmonicas of electrical machines; 2.62 to carry out calculation of electromechanical transition processes in electric drives.
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BGM.03 Norms of agrarian law in the processes of agricultural production

Purpose: to acquaint with the basic theoretical provisions of the agrarian right of the Republic of Kazakhstan; to study regulation of agricultural activities, legal regulation of the separate directions of agricultural activities, a state legal mechanism of regulation of agrarian legal relationship in RK.

Tasks of the module: to acquaint students with theoretical provisions of the land right; to give the detailed characteristic of the land legislation of the Republic of Kazakhstan, history of its development; to reveal distinctive features of the modern land legislation of Kazakhstan; to show a role of the land right in creation of society with market economy; to teach the correct application of precepts of law of the land legislation; to cover interrelation of the land right with a legal regime of other natural resources; to orient in features of a legal regime of separate types of lands, in specifics of application of management functions in regulation of land legal relationship; to characterize distinctive features of a state legal mechanism of use of responsibility for violations of the land legislation.

Content of the module:

Module 1: Concept, subject, methods, principles of the agrarian right. Agrarian offenses.

Practical lesson 1. Concept, principles of the agrarian right, offense. Sources of the agrarian right.

Practical lesson 2. Sources of the agrarian right.

Module 2. State legal mechanism of regulation of agrarian offenses.

Practical lesson 3. State legal mechanism of regulation of agrarian offenses.

State legal department of agricultural industry in the period of the market relations.

Practical lesson 4. State legal department of agricultural industry in the period of the market relations.

Scope of out-of-class independent work: Measures of the state support of agricultural producers.

Orgnizatsionno-pravovye forms of agricultural organizations and their legal status.

Practical lesson 5. Orgnizational and legal forms of agricultural organizations and their legal status.

Legal regulation of an agricultural private entrepreneurship and personal household of citizens in the Republic of Kazakhstan.

Practical lesson 6. Legal regulation of an agricultural private entrepreneurship and personal subsidiary farm of citizens in RK.

Scope of out-of-class independent work: Main characteristic of the Law RK state regulation of development of agro-industrial complex and rural territories" of 08.07.2005

Legal regulation of use of the earth and other natural resources in agricultural production.

Practical lesson 7. Legal regulation of use of the earth and other natural resources in agricultural production.

Scope of out-of-class independent work: Regulatory issues of cotton activities in the RK.

Legal regulation of environmental protection in agricultural industry.

Practical lesson 8. Legal regulation of environmental protection in agricultural industry.

Legal support of food security.

Practical lesson 9. Legal support of food security.

Scope of out-of-class independent work: Public administration and regulation of the market of grain.

Legal support of the economic mechanism of regulation of the agrarian relations.

Practical lesson 10. Legal support of the economic mechanism of regulation of the agrarian relations.

Legal regulation of separate types of agricultural activities.

Practical lesson 11. Legal regulation of separate types of agricultural activities.

Legal regulation of contractual relations in agricultural industry.

Practical lesson 12. Legal regulation of contractual relations in agricultural industry.

International legal cooperation in the field of the agrarian relations. Ways of enhancement and prospect of development of the agrarian law of the RK.

Practical lesson 13. International legal cooperation in the field of the agrarian relations. Ways of enhancement and prospect of development of the Agrarian Law in the Republic of Kazakhstan.

Learning outcomes	Assessment criteria The student has to (verbs: be able, define, choose, estimate, receive, create, carry out, explain, reveal, collect, establish, use, make, prove, etc.)
Upon successful completion of this module PO 3 the student has to: introduce norms of agrarian law in the processes of agricultural production Is able to introduce the norms of agrarian law in the processes of agricultural production	3. 1. to be able to organize a workplace; 3.2. to own professional lexicon; 3.3 to perform work under the leadership of specialists of higher qualification; 3. 4 to own computer methods of collection, storage and information processing; 3. 5 to be able to work in team, to communicate effectively with colleagues, a management, consumers 3. 6 to use information and communication technologies for enhancement of professional activity; 3. 7 to be able to work with reference books and catalogs; 3.8 to make decisions in standard and unusual situations and to bear their responsibility; 3.9 to be able to organize own activities, determining methods and methods of accomplishment of professional tasks, estimations their efficiency and quality;

	<p>3.10 to perform search, to make the analysis and assessment of information necessary for statement and the solution of professional tasks;</p> <p>3.11 to show readiness for fixed professional growth, acquisition of new knowledge;</p> <p>3.12 to own modern information technologies;</p> <p>3.13 to exercise control of quality of the performed works;</p> <p>3.14 to apply the regulatory legal acts governing the relations in agricultural industry;</p> <p>3.15 to master sufficient preparation for acquisition of knowledge in the field of advanced technologies;</p> <p>3.16 to be able to create conditions for advanced training of personnel;</p> <p>3.17 to make an experiment by the set techniques with handling and the analysis of results;</p> <p>3.18 to be able to plan work of personnel;</p> <p>3.19 to carry out the organization for creation or reorganization of production sites;</p> <p>3.20 to solve problems, to estimate risks and to make decisions in unusual situations;</p> <p>3.21 to be able to set the purpose, to motivate activities of subordinates;</p> <p>3.22 to organize and control work of personnel with acceptance on itself responsibility for result of task performance;</p> <p>3.23 to explain essence and functions of the agrarian right;</p> <p>3.24 to apply the laws "Property right" in professional activity;</p> <p>3.25 to be able to use the laws "Legal Status Agricultural Hozyaystvubshchikh of Subjects" and "Legal Entrepreneurship Bases" "Land right", "Bases of an ecological pravo", "Legal regulation of work in agricultural enterprises and the organization", "Disciplinary and liability", "Employment disputes and an order of their consideration";</p> <p>3.26 to explain purpose of the economic agreement and its role in a dyatelnost of agricultural enterprises and the organization;</p> <p>3.27 to master skills of creation of kinds of the economic agreement;</p> <p>3.28 to apply achievements of science in the field of jurisprudence and the main directions of development of the agrarian right;</p> <p>3.29 to be able to use regulatory legal acts, the governing relations concerning ownership, use and the order of property;</p> <p>3.30 to analyze regulations;</p> <p>3.31 to be guided in articles of civil and criminal codes, in the legislation about administratively – legal responsibility for legal violation</p>
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BGM.04 Module: A system of electric energy counting on the basis of economic management

Purpose: forming at students of knowledge and abilities in the field of the theory and practice funktsioni-a rovaniye of the energy entities in market conditions taking into account their technological features.

Tasks of module: acquisition of theoretical knowledge of economy; receipt of idea of a power industry role in development of economy of RK and about the problems connected with integration of power industry into market economy; acquisition of knowledge of methods of regulation of load of consumers, forming of costs for energy, creations of rates for energy and fuel, measure calculation of activities of the entity; mastering methodology of the feasibility statement on the made decisions.

Introduction in the module: This discipline studies possibilities of enhancement of economic board in an electrical power industry, methods of increase in reliability and

quality of energy, a labor productivity, increase in efficiency of use of resources, and also methods of the feasibility statement on ways of a strategic development of power.

Content of the module:

1. Energy industry, capital investments in power and property, plant and equipment of the power entities

1.1. Characteristics of the energy entities and energy resources, economy of their use. Energy industry as a part of national economy. Concept of economy and production organization of enterprise scales (power company). Object of studying of a rate. A subject and a method of a rate, its structure, tasks, interrelations with other disciplines of the curriculum, a role in training of engineers of energy specialties. Energy economy of the country. Power making and energy-requiring an economy fikation. Energy economy of the industry and fuel and energy complex (energy industry). Energy resources. Main terms and determinations: energy; renewable and unrenewable energy resources; energy saving; an energy resource (primary and secondary - VER); efficiency of use of energy resources (energy efficiency); energy efficiency indicator; energy object; energy consumption. Basic provisions of the energy strategy of RK.

1.2. Balance of energy and capacity of a power supply system.

Balance of the electric power. Receipt and account parts of balance. Consumers of the electric power. Need for the electric power. Electric power expense on own needs. Technological expense of the electric power. Balance of capacity of a power supply system. A capacity allowance in a power supply system: load, emergency, repair, economic. The established and located capacities. Capacity gaps. Schedules of Electric Loadings (SEL): daily, week, monthly, annual, winter, spring, summer, autumn. SEL indicators: maximum, average, minimum loadings; basic, peak and semi-peak loadings; filling coefficient, coefficient of the minimum loading, growth coefficient, annual number of hours of use of loading. Balance of heat. Balance of fuel.

1.3. Capital investments in power industry. Classification and means of capital financing. Determination of cost efficiency of capital investments in an object. Financing of a construction of new power facilities. Crediting of a construction. Reconstruction. Modernization. Structure of capital investments in an energy drink. Estimate, or smetnofinansovy calculation: object and summary. Structure of the estimate integrated cost indexes (ICI). Estimated cost of the equipment. Creation of estimate financial calculation. Cost of installation and construction works. Depreciable cost. Depreciation of fixed assets. Physical deterioration. Obsolescence. Social depreciation. Ecological depreciation. Depreciation charges. Depreciation of fixed assets and their reproduction. Useful life of a property, plant and equipment. Classification of depreciation methods: linear; diminishing balance method; a method a cost depletion on the amount of numbers of years of a useful life (a cumulative method); a method of a cost depletion it is pro rata to production (works); the combined method. Influence of depreciation policy on economic results of a company performance. Fixed asset objects on which depreciation is not charged. Recovery, lease and disposal of a property, plant and equipment. Indicators of availability, movement and efficiency of use of a property, plant and equipment. Coefficient of receipt (input) of a property, plant and equipment. Coefficient of disposal of a property, plant and equipment. Coefficient of updating of a property, plant and equipment. Coefficient of liquidation of a property, plant and

equipment. Coefficient of a surplus of a property, plant and equipment. Coefficient of depreciation of fixed assets. Coefficient of the validity of a property, plant and equipment.

1.4. Features of structure of the fixed assets in the energy sector. Concept, structure and structure of a property, plant and equipment. Classification of a property, plant and equipment. Qualifier of fixed assets. Active and passive part of a property, plant and equipment. Evaluation methods of a property, plant and equipment. Original cost. Replacement cost. Residual cost. Salvage value. Revaluation of a property, plant and equipment, revaluation methods. Depreciable cost. Depreciation of fixed assets. Physical deterioration. Obsolescence. Social depreciation. Ecological depreciation. Depreciation charges. Depreciation of fixed assets and their reproduction. Useful life of a property, plant and equipment. Classification of depreciation methods: linear; diminishing balance method; a method a cost depletion on the amount of numbers of years of a useful life (a cumulative method); a method of a cost depletion it is pro rata to production (works); the combined method. Influence of depreciation policy on economic results of a company performance. Fixed asset objects on which depreciation isn't charged. Recovery, lease and disposal of a property, plant and equipment.

1.5. Features of structure of current assets in the energy sector. Economic content, structure and features of a working capital of the energy companies. A working capital in the sphere of production. Concept of revolving funds, their structure and structure. Assessment of the inventory stocks (IS) on actual cost: - purchased for a fee; - in case of their production by forces of the organization; - brought in the account of a contribution to the authorized capital; - received gratuitously; - purchased in exchange for other property other than a money.

Product cost. Costs of production. Labor instruments, objects of the labor, work. Standard rates of assignments on operation. Classification of production costs of products by economic elements and articles of calculation. A cost budget on production and sales of products of the energy companies. Material costs: costs for raw materials and main materials, costs for auxiliary materials, services of production nature, fuel costs, costs for purchased energy. Structure of material costs. Labor costs and assignments on social needs (Unified social tax). Other costs: taxes (water, land, transport, on reproduction of mineral resources); expenses and costs: on corrective maintenance, on advertizing, on preparation and retraining of personnel, on labor protection, on interest payment on the obtained credits, ecological payments, entertainment expenses, expenses on Research and Development and other contributions to the trust funds. Classification of production costs of products by articles of calculation. Calculation of cost value of the electric power and heat. Objects of calculation for power plants, for electric and thermal networks, for a power supply system, for power economy of industrial enterprise.

Group of costs under articles of calculation in an energy sector. Contents of articles of calculation of cost value of energy: fuel on the technological purposes, water on the technological purposes; the main compensation of production workers, additional payment of work of production workers, assignments on social needs from the salary of production workers, depreciation of a production equipment, expenses on content and operation of the equipment, expenses on preparation and development of production, shop expenses, general running costs. Totals

production household power consolidation activities: production (PHCA): material consumption, economic, ecological, estimative. Analysis of indicators.

2. Payment for labor, financial economy and reporting at the power entities.

2.1. Work, a personnel and compensation in the power engineering specialist.

Classification of personnel: workers of production, non-productive and employees (employees, engineering and technical staff, managers, administrative and management personnel). Work payment types: straight line price-work, price-work and bonus, time, time-bonus, accord, etc. Wage rate book. Minimum payment of work. Job grades. Indicators of awarding of workers and engineering and technical staff. Tariff and tariffless, "floating salaries", "on a commission basis" wages systems. Concept of a labor productivity and indicators of its measurement. Shortcomings of cost indicators of performance measurement of work. Performance indicators of use of a manpower in the energy sector. Regular coefficient. Content of tariff system: concept of the tariff charge, scale of charges, tariff coefficient, wage rate book (WRB). Differentiation of the tariff charges depending on working conditions: normal, heavy and harmful, and also on regions.

2.2. Economic indicators of activities of the power entities. Financial economy of the power entities. Sources of financial resources of the power entities. Own sources. Loan sources. The raised funds. Basic forms of a financial evaluation. Profit plan. Cash flow plan. Planned balance. Settlement and credits. Profit and profitability in the energy sector. Profit on sales of products. Proceeds from sales of products. Net profit. Level of a net profit. Amount of a goods sold. Working power of the power plant. Breakeven point of the power company. Bases of a financial analysis in an energy sector. Analytical coefficients.

2.3. Cost value in the energy sector. Product cost. Costs of production. Labor instruments, objects of the labor, work. Standard rates of assignments on operation. Classification of production costs of products by economic elements and articles of calculation. A cost budget on production and sales of products of the energy companies. Material costs: costs for raw materials and main materials, costs for auxiliary materials, services of production nature, fuel costs, costs for purchased energy. Structure of material costs. Labor costs and assignments on social needs (Unified social tax). Other costs: taxes (water, land, transport, on reproduction of mineral resources); expenses and costs: on corrective maintenance, on advertizing, on preparation and retraining of personnel, on labor protection, on interest payment on the obtained credits, ecological payments, entertainment expenses, expenses on Research and Development and other contributions to the trust funds. Classification of production costs of products by articles of calculation. Calculation of cost value of the electric power and heat. Objects of calculation for power plants, for electric and thermal networks, for a power supply system, for power economy of industrial enterprise. Group of costs.

2.4. Accounting and the reporting at the power entities. Position of accounting in a management system. Task complex of management of proizvodstvennokhozyaystvenny activities of the energy entity. Accounting types: opreativnotekhnicheskyy, statistical, accounting. Tasks of bukhgatersky accounting. Totals production power consolidation activities: production (PHCA): material consumption, economic, ecological, estimative. Analysis of indicators.

2.5. Features of pricing in the energy sector. Goods of "electrical energy" and its

main characteristics. Consumer behavior and product demand for electrical energy.

General information about goods "electrical energy". Consumer goods. Goods of technological appointment. Need for goods "electrical energy". Goods lifecycle. Demand, offer and price of goods. Consumer requirements to quality of power supply. Product and its environment. Competitiveness of an electrical energy in the market. Economic parameters of competitiveness. Consumer parameters of competitiveness. Goods quality. A consumer behavior in the market and the product demand "electrical energy". Quantitative approach to the analysis of usefulness. Marginal utility. Serial approach to the analysis of usefulness. Emotional neglect curve. Balance point. Demand, offer and price of goods. Elasticity of demand at the price. Nature of the shift in demand at the regional level.

2.6. Analysis of sales of products and marketing plan of the power company.

Problem of assessment of damages from violation of reliability of power supply. Forecasting of electric loadings. Short-term, mid-term, long-term forecasting. Analysis of forecasting methods. Methods and forecasting models. Linearly - additive prognostic model Holt's method. Holt's method with Muir's modifications. Method of adaptive smoothing of Brown. Sezonodekompozitsionny prognostic model of Holt-Vinter. Model of neural networks. Market segmentation and its essence. Market segment. Market segmentation. Criteria of segmentation. Target market. Basic concepts and tasks of sale. Distribution channels. Width of the channel. Wholesale dealer. Retail dealer. Trade exchange. Sales methods of goods. Determination of the optimum sales channel.

2.7. Investments in the energy industry. Business planning of investment projects. Investment projects. Evaluation methods of the investment project. Investment cycle. Preinvestment, investment, production stage. Economic case. Business plan of the investment project. Project description or summary. Name of the project; description of the entity, its specialization and background of development. Business idea of the project, strategic objectives and tasks of the entity, resources and profit of the entity, financial condition and risks. Organizational plan. Legal plan. Ecological information. Social reaction. Financial plan. Strategy of financing.

2.8. Criteria of financial and economic investment soundness in power facilities. Organizational plan. Organizational scheme of the entity. Characteristic of personnel. Payment issues of work and work incentives of a managing personnel. Organizational structure of the entities. Control link. Step (level) of management. Office (body) of management. Structural division. Functional structural division. Production structural division. Organization of energy economy of the entity. Organization of tool economy. Organization of transport economy of the entity. Organization of warehouse economy of the entity. Efficiency evaluation of change of an organizational structure

2.9. Operational corrective maintenance and network planning

Depreciation and recovery of the equipment. Physical deterioration. System of planovopredupreditelny repair. Organization of repair service of the entity. Tasks and Concept price and rate. The Odnostavochny, two-part and differentiated on zones (time) of days rates. Penalty areas and reduced rates. Standard profit. Benefits and shortcomings of various tariff systems. The bodies regulating rates: Public service on rates and its regional departments. Structure of service. Rates on tension ranges. An average rate of the power supplying organization. The fixed and regulated rates.

Investment rates. Indexation of rates. Forming of rates in the competitive market. The declared and practical half-hour capacity of the consumer. Deviations or no balance.

2.10. Value assessment of project works and project appraisal. Choice of an optimal variant of a power facility. Blueprint stages. Characteristic of costs. Project organizations. Customers, contract organizations, communication of customers with the contract and project organizations. An order of development of documentation on a construction of buildings and constructions. Engineering design (detailed design). Working documentation. Proyektrivroaniye stages. The leading materials for designing. Value assessment of project works. Rules of calculations of the prices of project works. Basic price for project works. A price index on project works. Project appraisal. Order of conducting state examination. Expert opinion.

Practical training

1. Characteristics of the energy entities and energy resources, economy of their use. Capital investments in power. Investment into an energy industry.

2. Economic indicators of activities of the power entities. Features of structure of the main and current assets in an energy sector.

3. Calculation of operating costs of an energy object.

4. Features of pricing in an energy sector. Analysis of sales of products and marketing plan of the power companies.

5. Criteria of financial and economic investment soundness in power facilities. A problem of assessment of damages from violation of reliability of power supply.

6. Organizational plan. Calculation of need for a manpower.

8. Payroll calculation. Calculation of cost value of the electric power. Choice of an optimal variant of a power facility.

Learning outcomes Upon successful completion of this module the student has to:	Assessment criteria The student has to (verbs: be able, define, choose, estimate, receive, create, carry out, explain, reveal, collect, establish, use, make, prove, etc.)
PO 04 Organize a system of electric power counting on the basis of economic management. is able to organize a system of counting of electric energy on the basis of economic management	4.1. to master professional lexicon; 4.2 to perform work under the leadership of specialists of higher qualification; 4. 3 to own computer methods of collection, storage and information processing; 4. 4 to be able to work in team, to communicate effectively with colleagues, a management, consumers 4. 5 to use information and communication technologies for enhancement of professional activity; 4. 6 to be able to work with reference books and catalogs; 4.7to make decisions in standard and unusual situations and to bear their responsibility; 4.8 to be able to organize own activities, determining methods and methods of accomplishment of professional tasks, estimations their efficiency and quality; 4.9 to perform search, to make the analysis and assessment of information necessary for statement and the solution of professional tasks; 4.10 to show readiness for fixed professional growth, acquisition of new knowledge;

	<p>4.11 to own modern information technologies;</p> <p>4.12 to exercise control of quality of the performed works;</p> <p>4.13 to apply the regulatory legal acts governing the relations in agricultural industry;</p> <p>4.14 to master sufficient preparation for acquisition of knowledge in the field of advanced technologies;</p> <p>4.15 to be able to create conditions for advanced training of personnel;</p> <p>4.16 to make an experiment by the set techniques with handling and the analysis of results;</p> <p>4.17 to be able to plan work of personnel;</p> <p>4.18 to carry out the organization for creation or reorganization of production sites;</p> <p>4.19 to solve problems, to estimate risks and to make decisions in unusual situations;</p> <p>4.20 to be able to set the purpose, to motivate activities of subordinates;</p> <p>4.21 to organize and control work of personnel with acceptance on itself responsibility for result of task performance;</p> <p>4.22 to explain the main terms and determinations: energy; renewable and unrenovable energy resources; energy saving; an energy resource (primary and secondary - VER); efficiency of use of energy resources (energy efficiency); energy efficiency indicator; energy object; energy consumption;</p> <p>4.23 to apply basic provisions of the energy strategy of the RK in practical activities;</p> <p>4.24 to determine balance of the electric power;</p> <p>4.25 to determine receipt and account parts of balance;</p> <p>4.26 to determine an electric power expense on own needs, a technological expense of the electric power;</p> <p>4.27 to determine balance of capacity of a power supply system;</p> <p>4.28 to explain a capacity allowance in a power supply system: load, emergency, repair, economic, the established and located capacities, capacity gaps;</p> <p>4.29 to build the schedules of electric loadings (SEL): daily, week, monthly, annual, winter, spring, summer, autumn;</p> <p>4.30 to differentiate SEL Indicators: maximum, average, minimum loadings; basic, peak and semi-peak loadings; filling coefficient, coefficient of the minimum loading, growth coefficient, annual number of hours of use of loading;</p> <p>4.31 to determine balance of heat, balance of fuel;</p> <p>4.32 to explain classification and means of capital financing;</p> <p>4.33 to identify the cost efficiency of capital investments in an object. Financing of a construction of new power facilities;</p> <p>4.34 to explain structure of capital investments in the energy sector;</p> <p>4.35 to constitute the estimate, or to carry out smetnofinansovy calculation: object and summary.</p> <p>4.36 sostavlyat estimate financial calculation;</p> <p>4.37 to calculate the cost of installation and construction works, depreciable cost, depreciation of fixed assets, a physical deterioration, obsolescence, social depreciation, ecological izno;</p> <p>4.38 to determine the depreciation charges, depreciation of fixed assets and their reproduction;</p> <p>4.39 to explain influence of depreciation policy on economic results of a company performance;</p> <p>4.40 to use the qualifier of fixed assets;</p>
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	<p>4.41 to determine influence of depreciation policy on economic results of a company performance;</p> <p>4.42 to explain a concept of revolving funds, their structure and structure. Assessment of the inventory stocks (IS) on actual cost: - purchased for a fee; - in case of their production by forces of the organization; - brought in the account of a contribution to the authorized capital; - received gratuitously; - purchased in exchange for other property other than a money;</p> <p>4.43 to calculate product cost, costs of production;</p> <p>4.44 to constitute a cost budget on production and sales of products of the energy companies;</p> <p>4.45 to calculate material costs: costs for raw materials and main materials, costs for auxiliary materials, services of production nature, fuel costs, costs for purchased energy;</p> <p>4.46 to calculate labor costs and assignments on social needs (Unified social tax), other costs: taxes (water, land, transport, on reproduction of mineral resources); expenses and costs: on corrective maintenance, on advertizing, on preparation and retraining of personnel, on labor protection, on interest payment on the obtained credits, ecological payments, entertainment expenses, expenses on Research and Development and other contributions to the trust funds;</p> <p>4.47 to constitute calculation of cost value of the electric power and heat;</p> <p>4.48 to apply contents of articles of calculation of cost value of energy: fuel on the technological purposes, water on the technological purposes; the main compensation of production workers, additional payment of work of production workers, assignments on social needs from the salary of production workers, depreciation of a production equipment, expenses on content and operation of the equipment, expenses on preparation and development of production, shop expenses, general running costs;</p> <p>4.49 to determine a work payment type: straight line price-work, price-work and bonus, time, povremennopremialny, accord, etc.</p> <p>4.50 to use a wage rate book;</p> <p>4.51 to explain content of tariff system: concept of the tariff charge, scale of charges, tariff coefficient, wage rate book (WRB). 4.63 to carry out differentiation of the tariff charges depending on working conditions: normal, heavy and harmful, and also on regions.</p> <p>4.52 to develop the cash flow plan;</p> <p>4.53 to determine amount of a goods sold;</p> <p>4.54 to determine labor costs and assignments on social needs (Unified Social Tax), other costs: taxes (water, land, transport, on reproduction of mineral resources); expenses and costs: on corrective maintenance, on advertizing, on preparation and retraining of personnel, on labor protection, on interest payment on the obtained credits, ecological payments, entertainment expenses, expenses on Research and Development and other contributions to the trust funds;</p> <p>4.55 to determine totals production household power consolidation activities: production (PHCA): material consumption, economic, ecological, estimative;</p> <p>4.56 to calculate economic parameters of competitiveness;</p> <p>4.57 to determine marginal utility;</p> <p>4.58 Serial approach to the analysis of usefulness. Emotional neglect curve. Balance point.</p>
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	4.59 to carry out forecasting of electric loadings; 4.60 to constitute the business plan of the investment project; 4.61 to explain payment issues of work and work incentives of a managing personnel; 4.62 to determine benefits and shortcomings of various tariff systems; 4.63 to explain forming of rates in the competitive market; 4.64 to apply rules of calculations of the prices of project works, a price index on project works; 4.65 to explain purpose of project appraisal.
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PM.00 Professional modules

PM.01 Mounting, alignment of devices of relay protection and automation and electric supply systems

Purpose: Formation of systematic knowledge of devices of relay protection and automatic equipment which are used in systems of electrical power supply for protection of the capital equipment against damages.

Tasks: assimilation of the principles of creation of devices of relay protection and automatic equipment; study of types and constructions of the relay and diagrams of relay protection and automatic equipment, their device and principles of action; mastering principles and service regulations, calculations of installations of protection, methods of checks and adjustments of devices of relay protection and automatic equipment.

Introduction to the module: Relay protection realizes automatic elimination of damages and the abnormal modes in an electrical part of power supply systems and is the major system ensuring their reliable functioning.

Value of relay protection especially increases in the modern conditions in connection with the continuing growth of power of the power plants, growth of tension of electrical networks, combining of power systems in a single system. There is a transfer of relay protection to new microelectronic technology.

Content of the module

Module 1. Relay Protection and Automation in the systems of electrical power supply.

The general concepts about relay protection and the relay. Assignment of relay protection, damage to electric sets, requirements to the RP, RP elements.

Module 2. Maximum current protection in radial lines of transmissions.

Maximum Current Protection (MCP) of transformers, generators, power lines (power line), security circuits on a direct and alternating current. The current cut-off (lines, transformers, engines), principles of operation of the current cut-off, the instantaneous current cut-off,

Module 3. Longitudinal and cross differential current protection.

Assignment and types of longitudinal differential protection: transformers, generators, buses, power line. their differences, merits and demerits. Assignment cross differential the current protection.

Module 4. The current ground fault protections on a network with a glukhozazemlenny neutral.

Principle of operation, variety of protection. The filter of current of the zero sequence in protection.

Module 5. Protection against ground faults on networks with small earth fault currents.

Currents and tension in case of single-phase ground fault. Main security requirements; principles of execution of protection.

Module 6. Automatic control of tension on substations.

Automatic equipment "switch-offs – switching on of static condensers, the synchronous compensators. Automatic voltage controller of transformers.

Module 7. Automatic equipment of the synchronous generators.

Automatic synchronization of generators: exact synchronization. Automatic synchronization of generators: samosinkhronizaiya.

Approximate list of seminar lessons.

Module 1. Calculation of rated currents and short-circuit currents.

1. In concrete units

1. In the relative units

Module 2. Calculation as much as possible the current protection.

1. Transformer

1. Power lines

2. Generator

Module 3. Calculation of the current cut-off of the transformer.

1. Transformer

1. Power lines

2. Generator

Module 4. Calculation of differential protection.

1. Transformer

1. Power lines

Approximate list of the topics of laboratory works

1. RTM relay: a study of the device, the principle of operation, test and adjustment of the relay on the bench by means of Accelerated Preventive Protection.

1. RT-40 and RN-54 relay: a study of the device, the principle of operation, test and adjustment of the relay on the bench by means of Accelerated Preventive Protection.

1. EV-136 relay: a study of the device, the principle of operation, test and adjustment of the relay on the bench by means of Accelerated Preventive Protection.

1. RTN-565, RBM-177 relay: a study of the device, the principle of operation, test and adjustment of the relay on the bench by means of Accelerated Preventive Protection.

1. Test of electromagnetic alternating current relays and tension

1. Test of the induction current relay

1. Setup of settings of the maximum current protection of a radial network

1. Setup of relay protection of the double-coiled power transformer with a one-sided supply

The approximate list of subjects of independent work under the leadership of the teacher

1. The relay and their varieties, methods of connection of the relay and their image on drawings, methods of impact of the Relay Protection on the switch, sources of operational

current, of the Relay Protection types: the current protection, differential, distant

1. As much as possible the current protection with lock on tension, behavior of Maximal Current Protections in case of double ground fault, a choice of current of actuating and an exposure of time, security check for sensitivity.

1. The current cut-off with time exposure, a non-selective current cut-off, a choice of current of actuating and an exposure of time, check of the current cut-off on sensitivity

1. Currents of not balance and their nature, calculation of settings and sensitivity of longitudinal differential protection, differential protection of transformers, features of the diagram and calculation of settings of protection, differential protection of buses, cross diff. protection of Electric Power Lines.

2. Multistage directional earth protection as addition to distant protection on the example of the Electrical Valve-1636 panel, calculation of settings.

3. Directional protection; reacting to the higher harmonics on a network.

4. Regulation assignment, automatic voltage controller of transformers (AVCT);

5. Automatic equipment of excitation of generators, excitation forsirovka, automatic equipment of blanking of a field (AEBF).

Approximate list of subjects of independent work

Module 1. The measuring Current Transformers (CT) and the Voltage transformers (VT) in the relay protection (RP) and diagrams of their connections.

1. Current transformers and transformers of tension in RZ

2. Requirements imposed to a TT and TN

Module 2. Relay of protection.

1. General principles of execution of the relay.

2. Digital Simens protections.

Module 3. Distant protection.

1. Principles of execution of the relay of resistance and current of exact operation

1. The reasons distorting operation of distant organs of protection.

2. Starting organs of distant protection.

3. Diagrams of distant protection of the DZ-2 and DZ-10 type, calculation of settings.

Module 4. Automatic equipment of power supply systems (APV).

1. The principles of operation of devices of automatic equipment on the basis of theoretical bases of transient phenomena in system: APV, locks from sweeps, a choice of settings.

Module 5. The current directional protection.

1. Need for directional protection on the power line with double-side a supply.

1. diagrams of protection and principles of action.

2. diagrams of switching on of the induction relay of the direction of power.

3. dead band of protection, choice of settings of protection.

Module 6. The current ground fault protections on a network with a deph-earthed neutral.

1. Principle of operation, variety of protection, multistage directional earth protection.

Module 7. Subject: Automatic equipment of the synchronous generators.

1. Automatic synchronization of generators: exact synchronization, self-synchronization, automatic synchronization;

Approximate list of subjects of independent work

Module 1. The measuring Current Transformers (CT) and the tension transformers (TT) in relay protection (Relay Protection) and diagrams of their connections.

1. Current transformers and transformers of tension in Relay Protection
2. Requirements imposed to a TT and TN

Module 2. Relay of protection.

1. General principles of execution of the relay.
1. Digital Simens are hardwired.

Module 3. Distant protection.

1. Principles of execution of the relay of resistance and current of exact operation
2. The reasons distorting operation of distant organs of protection.
3. Starting organs of distant protection.
4. Diagrams of distant protection of the DZ-2 and DZ-10 type, calculation of settings.

Module 4. Automatic equipment of power supply systems (APV).

1. The principles of operation of devices of automatic equipment on the basis of theoretical bases of transient phenomena in system: APV, locks from sweeps, a choice of settings.

Module 5. The current directional protection.

1. Need for directional protection on the power line with double-side a supply.
1. diagrams of protection and principles of action.
2. diagrams of switching on of the induction relay of the direction of power.
3. dead band of protection, choice of settings of protection.

Module 6. The current ground fault protections on a network with a deph-earthed neutral.

1. Principle of operation, variety of protection, multistage directional earth protection.

Module 7. Subject: Automatic equipment of the synchronous generators.

1. Automatic synchronization of generators: exact synchronization, samosinkhronizaiya, automatic synchronization;

1. Automatic equipment of excitation of generators, excitation forsirovka, automatic equipment of blanking of a field (AEBF).

Learning outcomes Upon successful completion of this module the student has to:	Assessment criteria The student has to ((verbs: be able, define, choose, estimate, receive, create, carry out, explain, reveal, collect, establish, use, make, prove, etc.)
PO 01 Execute mounting, alignment of devices of the relay protection and automation of the electric power supply systems in agriculture Is able to execute	1. 1. to be able to organize a workplace; 1.2. to master professional lexicon; 1.3 to perform work under the leadership of specialists of higher qualification; 1. 4 to own computer methods of collection, storage and information processing; 1. 5 to be able to work in team, to communicate effectively with colleagues, a management, consumers

<p>mounting, alignment of the devices of the relay protection and automation of the electric power supply systems in agriculture</p>	<p>1. 6 to use information and communication technologies for enhancement of professional activity; 1. 7 to be able to work with reference books and catalogs; 1.8 to make decisions in standard and unusual situations and to bear their responsibility; 1.9 to be able to organize own activities, determining methods and methods of accomplishment of professional tasks, estimations their efficiency and quality; 1.10 to perform search, to make the analysis and assessment of information necessary for statement and the solution of professional tasks; 1.11 to show readiness for fixed professional growth, acquisition of new knowledge; 1.12 to master modern information technologies; 1.13 to exercise control of quality of the performed works; 1.14 to apply the regulatory legal acts governing the relations in agricultural industry; 1.15 to master sufficient preparation for acquisition of knowledge in the field of advanced technologies; 1.16 to be able to create conditions for advanced training of personnel; 1.17 to make an experiment by the set techniques with handling and the analysis of results; 1.18 to be able to plan work of personnel; 1.19 to carry out the organization for creation or reorganization of production sites; 1.20 to solve problems, to estimate risks and to make decisions in unusual situations; 1.21 to be able to set the purpose, to motivate activities of subordinates; 1.22 to organize and control work of personnel with acceptance on itself responsibility for result of task performance; 1.23 to generate ways of improvement of technical indicators of quality of management of electrical power installations; 1.24. to estimate service quality of power stations and automatic control; 1.25 to master skills of creation of electric circuits, using computer programs; 1.26 to explain purpose of relay protection, damage to electroinstallations, requirements to relay protection, of the relay protection elements; 1.27 to apply the most current protection (maximal current protections) of transformers, generators, power lines (electric supply lines), schemes of protection on direct and alternating current. Current cut-offs (lines, transformers, engines), principles of work of current cut-offs, instant current cut-offs; 1.28 to distinguish longitudinal and cross differential current protection 1.29 to apply to destination types of longitudinal differential protection: transformers, generators, buses, Electric supply lines, their differences, merits and demerits. Assignment cross differential the current protection; 1.30 to apply the current ground fault protections on a network with a starr neutral; 1.31 to explain the principle of operation, variety of protection. The filter of current of the zero sequence in protection; 1.32 to apply protection against ground faults on networks with small earth fault currents 1.33 to apply the main security requirements; principles of execution of protection; 1.34 to execute automatic control of tension on substations;</p>
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	1.35 to use automatic equipment "switch-offs – switching on of static condensers, the synchronous compensators; 1.36 to use the automatic voltage controller of transformers; 1.37 to use automatic equipment of the synchronous generators; 1.38 to execute automatic synchronization of generators: exact synchronization; 1.39 to execute automatic synchronization of generators: self-synchronization; 1.40 to explain the principles of operation of devices of automatic equipment on the basis of theoretical bases of transient phenomena in system: APV, locks from sweeps, a choice of settings; 1.41 to use the measuring Current Transformers (CT) and the tension transformers (TT) in relay protection and diagrams of their connections; 1.42 to define protection on electric supply lines with double-side power; 1.43. to read diagrams of protection and the principles of action; 1.44. to read diagrams of switching on of the induction relay of the direction of power. 1.45 to distinguish the relay and their varieties; 1.46 to own methods of connection of the relay; 1.47 to own methods of impact of the relay protection on the switch, sources of operational current; 1.48 to distinguish of the relay protection types; 1.49 to test electromagnetic alternating current relays and tension; 1.50 to test induction the current relay; 1.51 to align setting of the maximum current protection of a radial network; 1.52 to set up relay protection of the double-coiled power transformer with one-sided power.
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PM.02 Definition of the indices of reliability and quality of electric energy in power supply systems

Purpose: to prepare the qualified professional of all list of the tasks, capable to accomplishment, connected with providing consumers with an electrical energy in case of rated quality, reliability and profitability

Task: to determine tough communication between features of energy consumption and an operating mode of systems of power supply,

Introduction in the module: The electrical energy as goods is used in all spheres of activity of the person, has set of specific means and directly participates during creation of other types of products, influencing their quality. Increase in level of electrification in all industries of economy imposes high requirements of reliability of power supply.

Content of the module

Module 1. Introduction. The place of a rate in educational process the Main questions studied in the course.

Scope of out-of-class independent work: Optimization of emergency and repair operating modes of a power supply system.

Module 2. Reliability of systems of power supply industrial entity.

Main determinations and indicators of reliability of systems of power supply. Classification of electroreceivers by degree of uninterruptedness of power

supply. Quantity characteristics of uninterruptedness of systems of power supply. Mathematical methods of calculation of reliability of systems of power supply. Determination of damage from power supply violation.

Scope of out-of-class independent work: Calculation of reliability of SES with parallel and consecutive connection of elements. Calculation of reliability of SES with " m connection from n". Calculation of reliability of SES with mastic type of connections. Calculation of reliability of SES with the combined type of connections. Calculation of reliability of systems with reservation.

Module 3. The number of tension in systems of power supply of industrial enterprises. The main indicators the determining qualities of tension and their admissible values. influence of quality of tension on operation of receivers of an electrical energy and technological installations. Determination of an economic damage in case of shutdown of tension in systems of power supply of industrial enterprises. Quality control of tension in systems of power supply of industrial enterprises. Means and devices for mass quality control of tension. Methods and means of improvement of quality of tension in industrial power supply networks.

Approximate list of subjects of a practical training

1. Calculation of deviations of voltage in the power supply systems.
2. Choice of technical means of regulation of tension.
3. Calculation fluctuation of tension.
4. Calculation of a nesinusoidalnost in systems of power supply.
5. Calculation of a nessimetriya of tension in systems of power supply.
6. Calculation of reliability of elements of systems of power supply.
7. The choice a branch on transformers.
8. Calculation of influence of installation of batteries of condensers on tension level in system of power supply.
9. Calculation of reliability in systems of power supply with consecutive elements.
10. Calculation of reliability in systems of power supply with parallel elements.

Learning outcomes	Assessment criteria
Upon successful completion of this module the student has to:	The student has to ((verbs: be able, define, choose, estimate, receive, create, carry out, explain, reveal, collect, establish, use, make, prove, etc.)
PO 02. Define indices of reliability and quality of electric power in the power supply systems Is able to define the indices of reliability and quality of electric energy in the power supply systems	2. 1. to be able to organize a workplace; 2.2. to master professional lexicon; 2.3 to perform work under the leadership of specialists of higher qualification; 2. 4 to master computer methods of collection, storage and information processing; 2. 5 to be able to work in team, to communicate effectively with colleagues, a management, consumers 2. 6 to use information and communication technologies for enhancement of professional activity; 2. 7 to be able to work with reference books and catalogs; 2.8 to make decisions in standard and unusual situations and to bear their responsibility; 2.9 to be able to organize own activities, determining methods and methods of accomplishment of professional tasks, estimations their

	<p>efficiency and quality;</p> <p>2.10 to perform search, to make the analysis and assessment of information necessary for statement and the solution of professional tasks;</p> <p>2.11 to show readiness for fixed professional growth, acquisition of new knowledge;</p> <p>2.12 to master modern information technologies;</p> <p>2.13 to exercise control of quality of the performed works;</p> <p>2.14 to apply the regulatory legal acts governing the relations in agricultural industry;</p> <p>2.15 to master sufficient preparation for acquisition of knowledge in the field of advanced technologies;</p> <p>2.16 to be able to create conditions for advanced training of personnel;</p> <p>2.17 to make an experiment by the set techniques with handling and the analysis of results;</p> <p>2.18 to be able to plan work of personnel;</p> <p>2.19 to carry out the organization for creation or reorganization of production sites;</p> <p>2.20 to solve problems, to estimate risks and to make decisions in unusual situations;</p> <p>2.21 to be able to set the purpose, to motivate activities of subordinates;</p> <p>2.22 to organize and control work of personnel with acceptance on itself responsibility for result of task performance;</p> <p>2.23 to be able to generate ways of improvement of technical indicators of quality of management of electrical power installations;</p> <p>2.24. to estimate service quality of power stations and automatic control;</p> <p>2.25 to own skills of creation of electric circuits, using computer programs;</p> <p>2.26 to explain the main determinations and indicators of reliability of systems of power supply;</p> <p>2.27 to apply classification of electroreceivers by degree of uninterruptedness of power supply;</p> <p>2.28 to possess information on quantity characteristics of uninterruptedness of systems of power supply;</p> <p>2.29 to apply mathematical methods of calculation of reliability of systems of power supply;</p> <p>2.30 to determine damage from power supply violation;</p> <p>2.31 to carry out calculation of reliability of SES with parallel and consecutive connection of elements;</p> <p>2.32 to carry out calculation of reliability of SES with " m connection from n";</p> <p>2.33 to carry out calculation of reliability of SES with mastic type of connections;</p> <p>2.34 to carry out calculation of reliability of SES with the combined type of connections;</p> <p>2.35 to carry out calculation of reliability of systems with reservation;</p> <p>2.36 to apply the main indicators the determining qualities of tension and their admissible values. influence</p> <p>2.37 to determine an economic damage in case of shutdown of tension in systems of power supply of industrial enterprises;</p> <p>2.38 to control qualities of tension in systems of power supply of industrial enterprises;</p> <p>2.39 to apply means and devices to mass quality control of tension;</p> <p>2.40 to apply methods and means of improvement of quality of tension in industrial power supply networks;</p>
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	2.41 to carry out .rascht tension deviations in systems of power supply; 2.42 to carry out the choice of technical means of regulation of tension; 2. 43 to carry out calculation of fluctuations of tension; 2. 44 to carry out calculation of a nesinusoidalnost in systems of power supply; 2.45 to carry out calculation of a nessimetriya of tension in systems of power supply; 2.46 to carry out calculation of reliability of elements of systems of power supply; 2.47 to carry out the choice a branch on transformers; 2.48 to carry out calculation of influence of installation of batteries of condensers on tension level in system of power supply; 2.49 to carry out calculation of reliability in systems of power supply with consecutive elements; 2.50 to carry out calculation of reliability in systems of power supply with parallel elements.
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PM.03. Mounting and maintenance and repair of electric facilities

Purpose: Studying of bases of automatic equipment and automation of engineering procedures of various productions, the automated management information systems of different function, automated systems of acceptance, handling and data transmission of different function, automated systems of designing

Task of module: To master modern methods of calculation of parameters of engineering procedure as object of management.

Content of the module:

Module 1. The place and a role in system of training of specialists of page x. productions. Short sketch of development of automation of agricultural industry. Regional features of automation of agricultural production in the light of environmental problems.

Module 2. General information about objects automatic systems, elements and objects of management in agricultural production. Basic concepts and principles of creation of the systems of automatic control (SAC). Mathematical description of linear continuous management systems. Stability of systems of automatic control. Types and types of automation of agricultural industry.

Module 3. Technical means of automatic equipment. General information. The perceiving elements and sensors. The comparing devices. The setting devices. Amplifiers. Actuation mechanisms. Automatic equipment relay. Logical elements. Regulators.

Module 4. Automation of engineering procedures. Automation of engineering procedures in the protected soil. Automation of engineering procedures of storages of agricultural products. Automation of engineering procedures in a forage production. Automation of water supply and irrigation. Automation of engineering procedures in poultry farming.

Module 5. Technical and economic efficiency. Technical and economic efficiency of automation of engineering procedures. Features of the technical and economic analysis of systems of automatic equipment in crop production, livestock production, poultry farming and melioration.

Approximate list of subjects of laboratory works:

1. Sensors and their static characteristics.
2. Research of sensors and regulators of temperature.
3. Relay and program devices of automatic equipment
4. Research of logical elements of automatic equipment.
5. Researches and setup of on-off system of automatic control.
6. Researches and setup of three-position system of automatic control.
7. Studying of bases and special functions of microprocessor konroller.

Approximate list of subjects of practical works

1. Studying of regulating documents in case of project development of automation of production processes.
2. Creation of schemes of automation. Studying of conditional graphic symbols of elements of automatic equipment.
3. Examples of creation of function charts.
4. Examples of creation of schematic diagrams.
5. Research of stability of systems of automatic equipment.
6. Reasons and choice of the regulator.
7. Calculation and setup of parameters of the regulator.
8. Study of function of microprocessor controllers.
9. Programming of microprocessor controllers.
10. Determination of efficiency of automation of productions in agriculture.
11. Research of sensors and regulators of temperature.
12. Relay and program devices of automatic equipment
13. Research of logical elements of automatic equipment.
14. Research and setup of on-off system of automatic control.
15. Research and setup of three-positional system of automatic control.
16. Study of bases and special functions of microprocessor konroller.

Approximate list of subjects of independent work

1. Reliability of industrial control system for agricultural installations.
2. Reasons and a choice of technical means for automation.
3. Multiechelon systems.
4. Devices and systems released by the industry (working machines, SCADA system, cabinets, stands).

The approximate list of subjects of independent work under the guidance of the teacher

1. The characteristic of a control object including the description of technological process, construction of the aggregate or the diagram of the product line and the requirement to automation.
2. Detection of managing directors, the perturbing influences and controlled values.
3. The experimental or analytical determination of direct and response characteristics of objects.
4. Development of the functional diagram of automatic system.

5. Development of the schematic diagram of control.
6. Choice of elements of automatic system.
7. Development of the algorithmic diagram.
8. Determination of stability of automatic system.
9. A choice of the adjusting link, calculation of tuning properties of the regulator.
10. Creation of the diagram of transient phenomenon and measure definition of quality.
11. Calculation and study of one of non-standard elements.

Questions of the course project:

Reasons and choice of an automation object. Development of the skeleton diagram of an automation object. Development of the functional and technical diagram of automation. Development of the schematic elektrichesky diagram. Automation development of systems. Calculation and choice of elements of automation (time cut-outs, fuses, magnetic actuators, thermal and intermediate relays, time delay switch, traveling (finite) switches (switches), buttons and posts of control). Design of a board or control panel object. Wiring design of connections of the circuit diagram. Actions for mounting and adjustment of the automated diagram of an uprvaleniye. Calculation of the main indices of reliability of the diagram of the automated control diagram. Calculation of the main indices of reliability of the control diagram object. Actions for labor protection and the security regulation by installation operation. Development of ecological actions. Calculation of technical and economic indices. Execution of a graphic part of the academic year project.

The results of study	Assessment criteria
<p>Upon successful completion of the module "Mounting and maintenance of electric facilities and automated systems" PO 03.</p> <p>The student is able to: perform mounting and maintenance of electric facilities and automated systems</p> <p>Is able to perform mounting and maintenance of electric facilities and automated systems</p>	<p>Has to:</p> <p>3. 1. to be able to organize a workplace;</p> <p>3.2. to own professional lexicon;</p> <p>3.3 to perform work under the leadership of specialists of higher qualification;</p> <p>3. 4 to own computer methods of collection, storage and information processing;</p> <p>3. 5 to be able to work in team, to communicate effectively with colleagues, a management, consumers</p> <p>3. 6 to use information and communication technologies for enhancement of professional activity;</p> <p>3. 7 to be able to work with reference books and catalogs;</p> <p>3.8 to make decisions in standard and unusual situations and to bear their responsibility;</p> <p>3.9 to be able to organize own activities, determining methods and methods of accomplishment of professional tasks, estimations their efficiency and quality;</p> <p>3.10 to perform search, to make the analysis and assessment of information necessary for statement and the solution of professional tasks;</p> <p>3.11 to show readiness for fixed professional growth, acquisition of new knowledge;</p> <p>3.12 to own modern information technologies;</p> <p>3.13 to exercise control of quality of the performed works;</p> <p>3.14 to apply the regulatory legal acts governing the relations in agricultural industry;</p> <p>3.15 to own sufficient preparation for acquisition of knowledge in the field of advanced technologies;</p>

	<p>3.16 to be able to create conditions for advanced training of personnel;</p> <p>3.17 to make an experiment by the set techniques with handling and the analysis of results;</p> <p>3.18 to carry out the organization for creation or reorganization of production sites;</p> <p>3.19 to solve problems, to estimate risks and to make decisions in unusual situations;</p> <p>3.20 to be able to set the purpose, to motivate activities of subordinates;</p> <p>3.21 to organize and control work of personnel with acceptance on itself responsibility for result of task performance;</p> <p>3.22 to be able to generate ways of improvement of technical indicators of quality of management of electrical power installations;</p> <p>3.23 to estimate service quality of power stations and automatic control;</p> <p>3.24 to own skills of creation of electric circuits, using computer programs;</p> <p>3.25 to use individual and collective remedies from defeat by electric current;</p> <p>3.26 to develop the instruction on security measures during the works in electroinstallations, at height and loading unloading works;</p> <p>3.27 to develop and carry out organizational actions for security measures when carrying out installation works in electroinstallations;</p> <p>3.28 to provide safe operation and to conduct supervision for working in electroinstallations;</p> <p>3.29 to designate and to competently state requirements about security measures when briefing workers;</p> <p>3.30 to possess information about the regionalnykhosobennostyakh of automation of agricultural production in the light of environmental problems;</p> <p>3.31 to master general information about objects automatic systems, elements and objects of management in agricultural production;</p> <p>3.32 to apply the basic concepts and the principles of creation of the systems of automatic control (SAC);</p> <p>3.33 to differentiate types and types of automation of agricultural industry;</p> <p>3.34 to use technical means of automatic equipment;</p> <p>3.35 to apply the perceiving elements and sensors comparing the devices setting devices, amplifiers, actuation mechanisms, automatic equipment relay, logical elements and regulators;</p> <p>3.36 to have skills on automation of engineering procedures in the protected soil;</p> <p>3.37 to have skills of automation of engineering procedures of storages of agricultural products;</p> <p>3.38 to have skills on automation of engineering procedures in a forage production;</p> <p>3.39 to have skills on automation of water supply and irrigation;</p> <p>3.40 to have skills on automation of engineering procedures in poultry farming, to explain technical and economic efficiency of automation of engineering procedures. Features of the technical and economic analysis of systems of automatic equipment in crop production, livestock production, poultry farming and melioration;</p> <p>3.41 to apply sensors and their static characteristics;</p> <p>3.42 to research sensors and regulators of temperature;</p> <p>3.43 to use the relay and program devices of automatic equipment;</p> <p>3.44 to study logical elements of automatic equipment;</p> <p>3.45 to study as well as align on-off systems of automatic control;</p>
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	3.46 to study and align three-position systems of automatic control; 3.47 to apply special functions of microprocessor controller; 3.48 to develop the block diagram of an object of automation; 3.49 to develop the functional and technical scheme of automation; 3.50 to develop the schematic electric circuit; 3.51 to develop system of automation; 3.52 to carry out calculation and the choice of elements of automation (automatic switches, safety locks, magnetic actuators, thermal and intermediate relays, a timer, traveling (final) switches (switches), buttons and posts of management); 3.53 to design boards or control panels of objects; 3.54 to develop schemes of connection of the schematic electric circuit; 3.55 to carry out installation and adjustment of the automated scheme of control; 3.56 to carry out calculation of the main indicators of reliability of the scheme of the automated scheme of management; 3.57 to carry out calculation of the main indicators of reliability of the scheme of management of an object; 3.58 to carry out actions for labor protection and safe engineering during the installation work; 3.59 to develop ecological actions; 3.60 to carry out calculation of technical and economic indicators.
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DM. 00 Additional modules (defined by the education institution)

DM.01. Manage structural subdivision

Purpose: To create skills to manage structural division in an energy sector

Tasks of module: Show the methods of the organization of production work at the entities, features of management in power industry, a quality management system in power industry, methods of management and planning, the organization of work of structural division.

Content:

Section 1. Management of the organization of structural division in power industry.

Social and economic characteristic of an industry of communication and structure. Types of subindustries of communication their characteristic and features. Organization of management of the industry and its divisions. Essence, principles, methods of management. Organizational structure of an industry. Type of organizational structures in the industry. Types of accounting entities in a communication industry. The organization of production work. Concept of production process, its structure. Types of production works: operational servicing, development of network, work accounting. Organizational and production structure. Organization of production work of station, linear shops.

Practical lesson 1. Measure calculation of work of CTS.

Essence and characteristic features of modern management. Features of management in power industry.

Management functions in activities of the technician. Methods of management. Communications in management. A quality management system in power industry. Participation in planning and the organization of work of structural division (a crew, the site) in the place of a work practice. Participation in job analysis of structural

division. Participation in the organization of work of group of contractors with use of various acceptances. The solution of problem and situational tasks at the choice of a method of managerial impact. Participation in control of respect for technological discipline, quality of works. Participation in control of effective use of processing equipment and the electric power. Acceptance and implementation of management decision.

Section 2. Organization of activities of division of MDK.

Organizational structure of energy economy of the entities and the organizations. Technical documentation. Work planning of structural division. Organization of work of structural division. Main indicators of effective use of processing equipment and electric power. The organization of control on a production site. The organization of work on labor protection on a production site. Advanced training of subordinate personnel. Preparation for upgrade of the electric and electromechanical equipment. The organization of the works connected with liquidation of emergencies.

Section 3. Work planning of structural division.

Measure calculation, characterizing overall performance of production division, use of the capital and service equipment. Participation in execution of the sheet of accounting of working hours and salary accrual to the employee of division. Studying of algorithms of acceptance of management decisions at the entity on various standard and unusual situations. Participation in preparation and holding a meeting with staff of the entity and division. Participation in holding by the head a disciplinary conversation with the employee of the organization who made minor offense. The description of problem situations in professional activity and development of options of management decisions on permission of these problems. Acquaintance with work types on upgrades of the electric and electromechanical equipment and studying of methods of their accomplishment, development of technologies of their carrying out. Accomplishment under the leadership of the worker having the right of independent work, separate transactions on implementation of the new equipment and development of advanced technologies. Performance of works on carrying out upgrade of the electric and electromechanical equipment, implementation of the new equipment and development of advanced technologies. Performance of works on preparation for carrying out testing, engineering certification and commissioning of again installed or repaired electric and electromechanical equipment.

Practical work 2. Measure calculation, characterizing overall performance of production division, use of the capital and service equipment.

Practical work 3. Maintaining repair and operational documentation.

Learning outcomes Upon successful completion of this module the student has to:	Assessment criteria The student has to ((verbs: be able, define, choose, estimate, receive, create, carry out, explain, reveal, collect, establish, use, make, prove, etc.)
PO. 01 Manage the structural division is able to manage the structural division	1. 1. to be able to organize a workplace; 1.2. to own professional lexicon; 1.3 to perform work under the leadership of specialists of higher qualification; 1. 4 to own computer methods of collection, storage and information processing;

	<p>1. 5 to be able to work in team, to communicate effectively with colleagues, a management, consumers</p> <p>1. 6 to use information and communication technologies for enhancement of professional activity;</p> <p>1. 7 to be able to work with reference books and catalogs;</p> <p>1.8 to make decisions in standard and unusual situations and to bear their responsibility;</p> <p>1.9 to be able to organize own activities, determining methods and methods of accomplishment of professional tasks, estimations their efficiency and quality;</p> <p>1.10 to perform search, to make the analysis and assessment of information necessary for statement and the solution of professional tasks;</p> <p>1.11 to show readiness for fixed professional growth, acquisition of new knowledge;</p> <p>1.12 to own modern information technologies;</p> <p>1.13 to exercise control of quality of the performed works;</p> <p>4.14 to apply the regulatory legal acts governing the relations in agricultural industry;</p> <p>1.15 to own sufficient preparation for acquisition of knowledge in the field of advanced technologies;</p> <p>1.16 to be able to create conditions for advanced training of personnel;</p> <p>1.17 to make an experiment by the set techniques with handling and the analysis of results;</p> <p>1.18 to be able to plan work of personnel;</p> <p>1.19 to carry out the organization for creation or reorganization of production sites;</p> <p>1.20 to solve problems, to estimate risks and to make decisions in unusual situations;</p> <p>1.21 to be able to set the purpose, to motivate activities of subordinates;</p> <p>1.22 to organize and control work of personnel with acceptance on itself responsibility for result of task performance;</p> <p>1.23 to be able to generate ways of improvement of technical indicators of quality of management of electrical power installations;</p> <p>1.24. to estimate service quality of power stations and automatic control;</p> <p>1.25 to give the economic characteristic of an industry of communication and its of feature;</p> <p>1.26 to own the principles and methods of management;</p> <p>1.27 to own skills of the organization of structure of an industry;</p> <p>1.28 to differentiate types of organizational structures in a communication industry;</p> <p>1.29 to differentiate types of production works on CTS;</p> <p>1.30 to exercise control of respect for technological discipline, quality of works;</p> <p>1.31 to exercise control of effective use of processing equipment and the electric power;</p> <p>1.32 to accept and realize management decisions;</p> <p>1.33 to own skills of the organization of structure of energy economy of the entities and organizations;</p> <p>1.34 to arrange technical documentation;</p> <p>1.35 to plan work of structural division;</p> <p>1.36 to be able to organize work of structural division</p> <p>1.37 to apply the main indicators of effective use of processing equipment and the electric power;</p>
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	1.38 to organize control on a production site; 1.39 to organize work on labor protection on a production site; 1.40 to perform preparation for upgrade of the electric and electromechanical equipment; 1.41 to organize work on liquidation of emergencies; 1.42 to carry out measure calculation, characterizing overall performance of production division, use of the capital and service equipment; 1.43 to take part in execution of the sheet of accounting of working hours and salary accrual to the employee of division; 1.44 to take part in preparation and holding a meeting with staff of the entity and division; 1.45 to take part in holding by the head a disciplinary conversation with the employee of the organization who made disciplinary offense; 1.46 to describe problem situations in professional activity and to develop options of management decisions on permission of these problems; 1.47 to master work types on upgrades of the electric and electromechanical equipment and studying of methods of their accomplishment, development of technologies of their carrying out; 1.48 to carry out under the leadership of the worker having the right independent work, separate transactions on implementation of the new equipment and development of advanced technologies; 1.49 to perform work on carrying out upgrade of the electric and electromechanical equipment, implementation of the new equipment and development of advanced technologies; 1.50 to perform work on preparation for carrying out testing, engineering certification and commissioning of again installed or repaired electric and electromechanical equipment.
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MO. 01 To maintain electric lighting systems

Purpose: forming of knowledge in the field of lighting and electrotechnical calculations of networks of lighting, devices of light sources and lighting installations.

Tasks: training of students for use of knowledge of designing of installations of electric illumination of production, public and residential objects.

Content of the module:

Section 1. Basic bases of the device of lighting installations. Basic bases of the device of lighting installations. Sight and lighting. Color in technology of lighting. Quality of lighting (direct brightness, contrast between details and a background, an illumination permanency in time, uniformity of lighting).

Section 2. Basic lighting concepts and units. Basic lighting concepts and units

Radiant energy and light flow, luminous intensity, illumination, ratio between luminous intensity and illumination. Chromaticity, brightness, ratios between illumination and brightness.

Lighting properties of materials (coefficients of reflection, absorption, transmission).

Practical work No. 1. The solution of tasks by determination of luminous intensity, illumination, a light flow, brightness and measurement of illumination of specific objects with various light sources

Section 3. Modern light sources. Modern light sources. Light source selection.

The device of glow lamps, the applied materials, the principle of work, technical characteristics, merits and demerits, safety regulations when servicing glow lamps. The device, the applied materials, physical essence of work of luminescent lamps, types of luminescent lamps, schemes of ignition of luminescent lamps. Characteristics and the main operational features of luminescent lamps, their merits and demerits, safety regulations when servicing luminescent lamps.

The arc mercury-quartz lamps of high pressure of DRL, DRI. The device, the applied materials, physical essence of work, the scheme of inclusion, merits and demerits, safety regulations in case of their servicing.

Special digit lamps (ksenovy, sodium, eritemny, bactericidal).

Section 4. Lighting fixtures. Lighting fixtures. Purpose of the lighting equipment. Lighting indicators of lamps. Classification of lamps, general characteristic of a range of lamps. Slot-hole lamps - light guides. Design of lighting fixtures (opened, protected, moisture-proof, closed, explosion-proof). Lamps for glow lamps; the device, types, a scope depending on environment conditions. Lamps with luminescent lamps; device, scope, protective corner, efficiency. Lamps for mercury-quartz lamps; device, scope. Safety regulations when servicing lamps.

Practical training No. 2,3

2. Studying of the device of lamps, methods of their connection and connection to electric network for glow lamps

3. Studying of the device single-tube, two-lamp, three - and four-lamp lamps and methods of their connection to electric network

Section 5. Basic principles of designing of a lighting part of lighting installations. Lighting part of lighting installations. Principles of regulation of lighting. Choice of illumination and coefficients of an inventory, System of lighting, lighting types. Arrangement of lamps and their height of a suspension. General rules of an arrangement of lamps taking into account access of their servicing, economic justification. Improving radiation in system of general lighting. Main methods of calculation of lighting and feature of illumination of some objects

Basic principles of calculation. Utilization rate method. Calculation of illumination for specific capacity. Illumination calculation by a dot method (on the horizontal plane, the inclined and vertical planes). Calculation of illumination from the shining line. Floodlight. The combined calculation method.

General information. Illumination of fire hazardous, explosive zones, public buildings, open spaces, territories of industrial enterprises, settlements, sports constructions.

Practical lessons

4. Illumination calculation by a utilization rate method

5. Illumination calculation by a dot method

6. Calculation of illumination from the shining line

7. Calculation of floodlight

Section 6. Power supply of electric lighting installations. Power supply of electric lighting installations

Choice of tension of networks. Introduction distributing devices. Power supplies and power lines. Schemes of creation of lighting networks, options of reservation

of food of lighting. Group networks (recommendations about placement of lamps about groups and phases, trace of lines of group network, compensation of jet capacity of lighting networks). Schemes of management of lighting.

Practical occupation No. 8 Studying of designs of distributing devices.

Section 7. Electric lighting networks. Electric lighting networks. Recommendations about the structure of networks of lighting. The choice of section of conductors on loading current. Protection of lighting networks. Settlement losses of tension. Calculation for loss of tension of electric networks. Determination of loss of tension in lines with uniform loading. Calculation of section of wires for the smallest consumption of non-ferrous metal. Grounding, zeroing and zero wires.

Practical training

9. The choice of the protective equipment for protection of lighting networks with various light sources. The choice of conduction products on current of loading and taking into account the choice of the protective device

10. Determination of loss of tension in lines with regularly distributed loading

11. Determination of sections of conduction products on the minimum consumption of color material

Learning outcomes Upon successful completion of this module the student has to:	Assessment criteria The student has to ((verbs: be able, define, choose, estimate, receive, create, carry out, explain, reveal, collect, establish, use, make, prove, etc.)
PO 04 To maintain electric light systems Is able to maintain the systems of electric lighting with observation of occupational health requirements	4.1. to be able to organize a workplace; 4.2. to own professional lexicon; 4.3 to perform work under the leadership of specialists of higher qualification; 4. 4 to own computer methods of collection, storage and information processing; 4. 5 to be able to work in team, to communicate effectively with colleagues, a management, consumers 4.6. to apply the main standard requirements according to Electrical Installation Code, fire safety rules, OSH rules; 4.7. to be able to work with electroreplacement and metalwork tools; 4.8 to master skills of reading electric circuits; 4. 9 to use information and communication technologies for enhancement of professional activity; 4. 10 to be able to work with reference books and catalogs; 4.11 to serve systems of an electric lighting 4.12 to be able to serve systems of an electric lighting 4.13 basic concepts of quality of lighting; 4.14 to explain basic bases of the device of lighting installations; 4.15 to estimate quality of lighting (direct brightness, contrast between details and a background, an illumination permanency in time, uniformity of lighting); 4.16 to apply to destination the basic lighting concepts and units 4.17 to remember ratios between light sizes; 4.18 to solve problems by determination of luminous intensity, illumination, a light flow, brightness; 4.19 to carry out measurement of illumination of specific objects with various light sources;

	<p>4.20 to explain concepts radiant energy and a light flow, luminous intensity, illumination, a ratio between luminous intensity and illumination, chromaticity, brightness, ratios between illumination and brightness;</p> <p>4.21 to consider lighting properties of materials (coefficients of reflection, absorption, a transmission) in professional activity;</p> <p>4.22 to solve problems by determination of luminous intensity, illumination, a light flow, brightness and measurement of illumination of specific objects with various light sources;</p> <p>4.23 to apply in professional activity modern light sources, safety regulations in case of their servicing;</p> <p>4.25 to carry out light source selection;</p> <p>4.26 to be able to apply materials, taking into account the principle of work and technical characteristics;</p> <p>4.27 to serve glow lamps, luminescent lamps, applying safety regulations;</p> <p>4.28 to determine merits and demerits of lighting installations;</p> <p>4.29 to explain the device, the applied materials, physical essence of work of luminescent lamps, schemes of ignition of luminescent lamps;</p> <p>4.30 to differentiate types of luminescent lamps;</p> <p>4.31 to define characteristics and main operational features of luminescent lamps, their merits and demerits;</p> <p>4.32 to determine arc mercury-quartz lamps of high pressure of mercury vapour lamp, mercury arc lamp by external signs;</p> <p>4.33 to explain the device, the applied materials, physical essence of work, the scheme of inclusion, merits and demerits arc mercury-quartz lamps of high pressure of mercury vapour lamp, mercury arc lamp;</p> <p>4.34 to use safety regulations when servicing lamps of Mercury vapor lamp, mercury arc lamp and special digit lamps (ksenovy, sodium, eritemny, bactericidal);</p> <p>4.35 on external signs ksenovy, sodium, eritemny and bactericidal lamps;</p> <p>4.36 to explain purpose of the lighting equipment;</p> <p>4.35 to use modern lighting fixtures to various light sources;</p> <p>4.36 to explain the device of modern lighting fixtures;</p> <p>4.37 at installation of lighting light sources to consider technical characteristics, a scope, methods of connection and accession to electric network;</p> <p>4.38 to execute connection of lamps to electric network;</p> <p>4.39 to explain purpose of the lighting equipment, lighting indicators of lamps;</p> <p>4.40 to remember classification of lamps and general characteristics of a range of lamps;</p> <p>4.41 to explain a purpose of slot-hole lamps – light guides;</p> <p>4.42 to remember design of lighting fixtures (opened, protected, moisture-proof, closed, explosion-proof);</p> <p>4.43 to differentiate lamps for glow lamps, the device, types, a scope depending on environment conditions;</p> <p>4.44 to remember the device, a scope, a protective corner, efficiency of lamps with luminescent lamps;</p> <p>4.45 to use lamps for mercury-quartz lamps for designated purpose taking into account the device and a scope;</p> <p>4.46 to carry out servicing servicing of lamps applying Safety regulations;</p> <p>4.47 to carry out connection of electric network lamps for glow lamps;</p>
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	<p>4.48 to differentiate devices single-tube, two-lamp, three - and the chetyrekhlampo-vykh of lamps and methods of their connection to electric network</p> <p>4.49 to explain purpose of the lighting equipment;</p> <p>4.50 to determine lighting indicators of lamps;</p> <p>4.51 to apply classification of lamps;</p> <p>4.52 to explain design of lighting fixtures;</p> <p>4.53 to explain devices of lamps, methods of their connection and connection to electric network for glow lamps;</p> <p>4.54 to explain devices single-tube, two-lamp, three - and the chetyrekhlampo-vykh of lamps and methods of their connection to electric network;</p> <p>4.55 to apply the principles of regulation of lighting;</p> <p>4.56 to carry out the choice of illumination and coefficients of an inventory;</p> <p>4.57 to differ the systems of lighting and types of lighting;</p> <p>4.58 consider in professional activity an arrangement of lamps and their height of a suspension;</p> <p>4.59 to apply general rules of an arrangement of lamps taking into account access of their servicing, economic justification;</p> <p>4.60 to apply the basic principles of calculation in practical activities: a utilization rate method, calculation of illumination for specific capacity, illumination calculation by a dot method (on the horizontal plane, the inclined and vertical planes), calculation of illumination from the shining line and calculation of floodlight;</p> <p>4.61 to differentiate illumination of fire hazardous, explosive zones, public buildings, open spaces, the territories of industrial enterprises, settlements and sports constructions;</p> <p>4.62 to explain essence of power supply of lighting installations;</p> <p>4.63 to determine type of a light source and the lamp;</p> <p>4.64 to arrange lamps and to constitute the scheme of their power supply;</p> <p>4.65 to pick up the respective distribution points;</p> <p>4.66 to carry out the choice of tension of networks;</p> <p>4.67 to explain purpose of introduction distributing devices, power supplies and a power line;</p> <p>4.68 to read schemes of creation of lighting networks and options of reservation of food of lighting;</p> <p>4.69 to explain appointment of group networks (the recommendation about placement of lamps about groups and phases, trace of lines of group network, compensation of jet capacity of lighting networks);</p> <p>4.70 to read schemes of management of lighting;</p> <p>4.71 to explain a design of distributing devices;</p> <p>4.72 to calculate losses of tension in electric networks;</p> <p>4.73 to determine the section of wires by the smallest expense of a color metakl.</p> <p>4.74 to carry out the choice of section of conductors on current of loading and protection of lighting networks;</p> <p>4.75 to carry out calculation for loss of tension of electric networks;</p> <p>4.76 to determine loss of tension in lines with uniform loading;</p> <p>4.77 to carry out calculation of section of wires for the smallest consumption of non-ferrous metal;</p> <p>4.78 to carry out the choice of the protective equipment for protection of lighting networks with various light sources;</p> <p>4.79 to carry out the choice of conduction products on current of loading and taking into account the choice of the protective device</p>
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MO. 00. Modules, defined by the educational institution

MO. 01. To implement modern lighting technical devices and electric technologies

Purpose: formation of knowledge in the field of the modern lighting engineering devices of light sources, lighting installations and use of electrotechnologies

Tasks: training of students for use of knowledge of design of installations of electric lighting of production, public and inhabited objects using innovations and enhancing electrotechnologies

Introduction to the module: In this module the modern achievements in the field of lighting engineering devices of light sources, lighting installations are used; possibilities of use the sovremnykh of electrotechnologies for the purpose of implementation of economic, esthetic and compact sources in agriculture.

Content of the module:

Module 1. Lighting engineering installations. Optical radiation. Law of lighting engineering. Luminous instruments and irradiators. Calculation of lighting engineering installations. Procedure of payments of lighting engineering installations. Types and systems of lighting. Heat sources of radiation. Bit sources of radiation of low and high pressure. Start-regulation devices. Agricultural lighting engineering installations.

Procedure of payments of lighting engineering installations. Method of power density. STU design procedure. Electrotechnical part of the project. Tasks of operation of lighting engineering installations. Means of access to luminous instruments. Modes and methods to a chewing obsl. Utilization of sources of optical radiations.

Practical work No. 1 Research of lighting engineering and electrical parameters of lamps of a naaklivaniye.

Practical work No. 2 illuminance Calculation with a dot metodl.

Types and types of lighting. Types and systems of lighting. Types of lighting. Systems of lighting. Layout charts of lamps. General rules. Profitability of placement of illuminators. Principles of rating of illuminance. Grounding of lighting engineering installations.

Practical work No. 3 Research of lighting engineering and electrical parameters of discharge lamps of low pressure.

Practical work No. 4 illuminance Calculation by a dot method.

Heat sources of lighting. Classification of electrical sources of optical radiation.

Osknovny laws thermal radiations. Characteristics of electrical sources of radiation. Tungsten glow lamps. Halogen glow lamps. Infrared emitters of agricultural purpose.

Bit sources of radiation of low pressure. Classification of bit sources of radiation. Principle of action. Ignition and stabilizing of discharge in lamps. Features of an electric discharge in gases and vapors of metals. Operation of discharge lamps on an alternating current. Luminescent lamps. Compact luminescent lamps.

Practical work No. 5. Research of lighting engineering and electrical parameters of discharge lamps of high pressure.

Practical work No. 6. Illumination calculation by a utilization rate method

Out-of-class independent work. Special sources of optical radiation: for crop

production, heating of animals and a bird, disinfecting of air, liquids, a container and agricultural products of low pressure.

Digit sources of radiation of high pressure. 9 Digit sources of radiation of high pressure. Mercury lamps of high pressure. Sodium lamps. Metalhalogen lamps. Xenon lamps.

Practical work No. 7 Research of lighting devices

Practical work No. 8 Choice of section of conductors for lighting installations

Out-of-class independent work. Special sources of optical radiation: for crop production, heating of animals and a bird, disinfecting of air, liquids, a container and agricultural products of high pressure.

Start regulating devices for digit lamps. Determination. Start regulating devices for digit lamps. Parameters start regulating devices. Block diagram of PRL. Compensation of jet capacity. Regulation of a light flow of digit lamps. Lighting electric installation devices.

Out-of-class independent work. Magnetic systems start regulating devices. Poll conduction to the start regulating devices.

Agricultural light-technical installations. Installations for illumination of plants. Installations of livestock rooms. Devices of medical appointment. Installations for drying.

Practical work No. 9 induction having heated the Research;

Practical work No. 10 Determination of inconsequential losses of tension.

Independent work. The seeming temperature. Methods of regulation of a radiant flow. Operation agricultural STU. Operational tasks of lighting installations. Means of access to light devices. Modes and methods of servicing. Utilization of sources of optical radiation.

Practical work 10. Research of element heating

Practical work 11. Calculation of parameters of the equipment of protection

Out-of-class independent work. Assessment of project decisions and regulating documents. Choice of the best methods of lighting of rooms and oabochikh of places. Choice of a method and oszhim of replacement of NS.

Module 2. Bases of electric heating. Having heated resistance. Special types of heating. Designs of heating installations. Special types of electrotechnology. 13 Bases of electric heating. Methods of heat supply of agricultural industry. Tasks of calculation of electrothermal installations. Determination of capacity and constructive sizes of the equipment. Thermal efficiency and specific expense of the electric power. Temperature conditions and energy indicators of the basic thermal processes of agricultural production.

Out-of-class independent work. Electrotechnology as science and area of the equipment. Characteristics of EMP as energy carrier. Absorption and transformation of energy of EMP in material environments, its mechanical, thermal. magnetic and chemical manifestations.

Having heated resistance. Methods of transformation of an electrical energy to warmth. Specific electric resistance of conductors. Electrocontact heating. Electrode heating. Tubular heating elements. Heating wires and cables.

Practical work No. 11. Research of an electrode water heater.

Practical work No. 12. Calculation of the IK-heater.

Out-of-class independent work. Requirements to materials and to a design of heating devices. Approximate calculation of heaters. Schemes of inclusion and to a regulation of capacity. Special types of heating. Electric arc heaters. Bases of induction heating. Dielectric heating. Plasma heating. Electronic heating. Thermoelectric heating and chilling.

Practical work No. 13. Research of electropulse installation.

Practical work No. 14. Calculation of the electrode heater.

Out-of-class independent work. Stability of burning and regulation of current of an arch. Features of an arch of alternating current and meadow welding, Welding transformers, Scope. Thermal pumps,

Designs of heating installations. Electric water heaters and boilers. Heating and ventilating electrocalorifer installations. Features of operation of heating installations. Installations of local heating.

Out-of-class independent work. Scope and classification. Sets of the microclimatic equipment. standard systems of automation of work. Design features, appointment and classification of household electric heaters.

Special types of electrotechnology. Electronic and ion technology. Separation of grain mixes in electric fields. Charging and sedimentation of aerosols. Power supplies. Handling of seeds and soil electric current. Electropulse technology. Ultrasonic and magnetic handling of material. Thermoelectric thermal pumps.

Practical work No. 14. Research of ultrasonic installation.

Practical work No. 15. Calculation of the voltage stabilizer.

Out-of-class independent work. Electric crown filters. Characteristic of magnetic field as physical factor and its technological properties. Application of methods of an electric technology for an intensification of processes and energy saving.

Project decisions on ensuring the set reliability of the equipment and safety of a service personnel.

Development of an electrotechnological processes. Use of an electrical energy for the thermal purposes. General task of calculation and designing. Technical and economic assessment of decisions.

Practical work No. 16. Luminescent analysis of agricultural products.

Practical work No. 17. Calculation of TEP of ELT-installations.

Learning outcomes Upon successful completion of this module the student has to:	Assessment criteria The student has to ((verbs: be able, define, choose, estimate, receive, create, carry out, explain, reveal, collect, establish, use, make, prove, etc.)
PO 01 Introduce modern light technical devices and electric technologies Is able to implement modern light technical devices and electric technologies	1.1. to be able to organize a workplace; 1.2. to master professional lexicon; 1.3 to perform work under the leadership of specialists of higher qualification; 1. 4 to master computer methods of collection, storage and information processing; 1. 5 to be able to work in team, to communicate effectively with colleagues, a management, consumers

	<p>1. 6 to use information and communication technologies for enhancement of professional activity;</p> <p>1. 7 to be able to work with reference books and catalogs;</p> <p>1.8 to be able to organize own activities, determining methods and methods of accomplishment of professional tasks, estimations their efficiency and quality;</p> <p>1.9 to perform search, to make the analysis and assessment of information necessary for statement and the solution of professional tasks;</p> <p>1.10 to show readiness for fixed professional growth, acquisition of new knowledge;</p> <p>1.11 to master modern information technologies;</p> <p>1.12 to master the skills of creation of electric circuits, using computer programs;</p> <p>1.13 to manage work of electrotechnical personnel;</p> <p>1.14 to exercise control for qualities of the performed works;</p> <p>1.15 to make decisions in standard and unusual situations and to bear their responsibility;</p> <p>1.16 to master the skills of creation of electric circuits, using computer programs;</p> <p>1.17 to manage work of electrotechnical personnel;</p> <p>1.18 to carry out Calculation of lighting installations;</p> <p>1.19 to explain essence of the general calculation principles and major factors influencing the accuracy of calculations;</p> <p>1.20 to master the methods of a dot method of calculation and a method of utilization rate;</p> <p>1.21 to execute calculation of schedules linear isoluxury;</p> <p>1.22 to apply classification of digit sources of radiation;</p> <p>1.23 to explain the principle of action, ignition and stabilization of the category in lamps;</p> <p>1.24 to consider features of electric discharge in gases and vapors of metals during the work of digit lamps on alternating current;</p> <p>1.25 to research lighting and electric parameters of digit lamps of high;</p> <p>6.26 to execute illumination calculation by a utilization rate method;</p> <p>1.26 to explain purpose of special sources of optical radiation: for crop production, heating of animals and a bird, disinfecting of air, liquids, a container and agricultural products of low pressure;</p> <p>1.27 to research lighting devices: mercury lamps of high pressure, sodium lamps, metalhalogen lamps and arc xenon lamps;</p> <p>1.28 to carry out the choice of section of conductors for lighting installations;</p> <p>1.29 to apply to destination special sources of optical radiation: for crop production, heating of animals and a bird, disinfecting of air, liquids, a container and agricultural products of high pressure;</p> <p>1.30 to differentiate start regulating devices for digit lamps;</p> <p>1.31 to consider parameters the start regulating devices in case of installation;</p> <p>1.32 to read structural the scheme PRA;</p> <p>1.33 to apply to destination agricultural lighting installations;</p> <p>1.34 to determine inconsequential losses of tension;</p> <p>1.35 to carry out assessment of project decisions and regulating documents;</p> <p>1.36 to carry out the choice of the best methods of lighting of rooms and workplaces, a method and mode of replacement of IS;</p> <p>1.37 to apply methods of heat supply of agricultural industry;</p>
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	<p>1.38 to solve problems of calculation of electrothermal installations;</p> <p>1.39 to determine capacity and constructive the equipment sizes, the thermal efficiency and a specific expense of the electric power, temperature conditions and energy indicators of the basic thermal processes of agricultural production;</p> <p>1.40 to research lighting devices;</p> <p>1.41 to explain purpose of electrotechnology as science and area of the equipment;</p> <p>1.42 to research characteristics of EMP as energy carrier;</p> <p>1.43 to explain the phenomena absorption and transformation of energy of EMP in material environments, its mechanical, thermal, magnetic and chemical manifestations;</p> <p>1.44 to explain the value of specific electric resistance of conductors;</p> <p>1.45 to differentiate electrocontact heating, electrode heating and tubular heating elements, heating wires and cables;</p> <p>1.46 to research an electrode water heater;</p> <p>1.47 to carry out calculation of the IK-heater;</p> <p>1.48 to fulfill requirements to materials and a design of heating devices;</p> <p>1.49 to carry out approximate calculation of heaters;</p> <p>1.50 to read schemes of inclusion and regulation of capacity;</p> <p>1.51 to differentiate the following types of heating: arc, induction, dielectric, plasma, electronic, thermoelectric heating and chilling;</p> <p>1.52 to research electropulse installation;</p> <p>1.53 to carry out calculation of the electrode heater;</p> <p>1.54 to explain application stability of burning and regulation of current of an arch, feature of an arch of alternating current and arc welding;</p> <p>1.55 to explain purpose of electric water heaters, boilers, heating and ventilating electrocalorifer installations;</p> <p>1.56 to consider features in case of operation of heating installations;</p> <p>1.57 to master skills of work with a set of the microclimatic equipment and standard systems on automation;</p> <p>1.58 to use classification of household electric heaters;</p> <p>1.59 to own bases of electronic and ion technology;</p> <p>1.60 to apply handling of seeds and the soil electric current;</p> <p>1.61 to master bases of electropulse technology, ultrasonic and magnetic handling of material;</p> <p>1.62 to be able to use thermoelectric thermal pumps;</p> <p>1.63 to research ultrasonic installation;</p> <p>1.64 to carry out calculation of the voltage stabilizer;</p> <p>1.65 to apply electrotechnology methods to an intensification of processes and energy saving;</p> <p>1.66 to make project decisions on ensuring the set reliability of the equipment and safety of a service personnel;</p> <p>1.67 to carry out development of electrotechnological and electrotechnological tprotsess;</p> <p>1.68 to carry out technical and economic assessment of decisions;</p> <p>1.69 to make the luminescent analysis of agricultural products;</p> <p>1.70 to carry out calculation of TEP of ELT-installations;</p> <p>1.71 to own methods of heating of dwellings and production rooms.</p>
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8. CURRICULUM PLAN

Speciality: **Electrification and automation of agriculture**

Qualifications: **Electrical fitter**

Electrician

Electrical technician

Junior Electrical Engineer

Mode of Study: intramural

Standard term of training:

on the basis of the basic secondary education

with obtaining qualification of: Electrical technician – 3 years 10 months

on the basis of the basic secondary education – **2 years 10 months**

with obtaining qualification of: Junior Electrical Engineer +10 months

Index	The name of the subjects, modules and professional practice	Form control			Amount of training time (hours)				Distribution of semester
		Exam	Set-off	Exchange rate project/job	TOTAL	Academic learning	Practical education*	Professional practice	
1	2				6	7	8	9	10
GD.00	General disciplines	5			1448	602	846		1,2,3
G H E D .00	General humanities and economic disciplines				405		405		3-10
GHD.01	Professional Kazakh (Russian) language				+	+	+		3,4
GHD.02	Professional foreign language				+	+	+		3,4
GHD.03	Physical culture				+	+	+		3,4,5,6,7,8,9.10
SED.02	Essentials of Economics, management and marketing				+	+	+		7
SED.03	Fundamentals of law in industries				+	+	+		8
	Qualification: 1518012 – Electrical Fitter								
BOM.00	Basic general professional modules				585	189	234	162	
BOM.01	Simulation of electrical circuits using software				90	9	45	36	3,4,5
BOM.02	Analysis of the electric system, electronic engineering and control their functions	5			270	90	108	72	3,4,5
БOM.03	Диагностирование электрических установок и трансформаторов				225	90	81	54	4,5,6

PM.00	Professional modules				630	270	216	144	
PM.01	Agricultural service of electrical installations and assemblies.				315	135	108	72	4,5,6
PM.02	Maintenance and provision of electricity for agriculture	6			315	135	108	72	4,5,6
Qualification: 151802 2 - Electrician									
BOM.00	Basic general professional modules				585	189	234	162	
BOM.01	Simulation of electrical circuits using software				90	9	45	36	3,4,5
BOM.02	Analysis of the electric system, electronic engineering and control their functions	5			270	90	108	72	3,4,5
BOM.03	Diagnosis of electric machines and apparatus				225	90	81	54	4,5,6
PM.00	Professional modules				630	216	240	174	
PM.01	Maintenance of electrical equipment and automation tools.	6			270	90	108	72	4,5,6
PM.02	Maintenance and provision of electricity for agriculture				270	90	108	72	4,5,6
PM.03	Rules of standardization and Metrology in agricultural production processes				90	36	24	30	4,5,6
Qualification: 151803 3 – Electrical technician									
BOM.00	Basic general professional modules				199	80	119		
BOM.01	Record keeping in the State language				64	26	38		7
BOM.02	Basics of Agronomy and animal husbandry				135	54	81		7,8
PM.00	Professional modules				810	208	314	288	
PM.01	Maintenance of electrical installations and automation.	7		7	225	61	92	72	6,7
PM.02	Maintenance and provision of electricity for agriculture	8		8	225	61	92	72	6,7,8
PM.03	Automation and mechanization of production processes				135	25	38	72	6,7,8
PM.04	Installation, maintenance and repair of electrical installations.	8			225	61	92	72	6,7,8
Qualification: 15180* * – Assistant electrician									
BOM.00	Basic general professional modules				495	97	146	252	
BOM.01	Unconventional energy sources in agriculture				135	25	38	72	8,9
BOM.02	Software when solving mathematical problems in electric power industry				135	25	38	72	8,9

BOM.03	Agrarian law standards in agricultural production processes				90	22	32	36	8
BOM.04	Electricity metering system based on economic management.	9			135	25	38	72	9
PM.00	Professional modules				585	97	146	252	
PM.01	Installation, adjustment devices of relay protection and automation systems of power supply	10			135	25	38	72	9,10
PM.02	The determination of indicators of reliability and quality of electric power in power supply systems	9			225	61	92	72	8,9
PM.03	Installation and maintenance of electrical installations and automation systems	10		9	225	61	92	72	9,10
DM.00	Additional modules (defined by the Organization)				90	22	32	36	
DM.01	Management of the structural unit of the organization.				90	22	32	36	9
PP.00	Training and professional practice				1440			1440	
PP.01	Trial practice				90			90	4
PP.02	Technological practice				900			900	6,8,9
PP.03	Technological (pre-diploma) practice for qualification: technician-electrician				216			216	10
PP.04	Technological (pre-diploma) practice for qualification: Mladshij engineer electrician				216				
IC.00	Intermediate certification:				288				
	Including: evaluation of the level of professional skills and qualifications				24				
FC.00	Final certification				72				
FC.01	Certification in educational institutions				48				10
FC.02	Evaluation of the level of professional skills and qualifications				24				6,8
	Total compulsory education				7200				
C	Consultation				No more than 100 hours for educational year				
E	Elective				No more than 4 hours per week				
	Total:				8100				

Note:

1) * practical training include: practical (laboratory) works, course works (projects), tests, etc.

2) When designing and implementing training programmes and work plans, the organizations of technical and vocational education may:

~ change up to 30% of the training time for mastering training material for cycles, and up to 30% for each discipline (module) and up to 50% of the production teaching and professional practice with maintaining the total number of hours of compulsory education;

~ choose different training technologies, forms, methods, organization and control of the educational process;


~ in accordance with the needs of employers, to change the curriculum content up to 30% on humanities and socio-economic modules, and up to 50% in professional modules, apprenticeship training and professional practice. Introduce additional modules in professional modules on demand of employers with preservation of the total number of hours/credits for compulsory education;

~ Select the form, procedure and periodicity of the monitoring learning achievement of students and intermediate certification of trainees;

3) Distribution by courses may vary depending on learning technologies, the specifics of the speciality, regional specificities and others.

9. The list of recommended equipment

No	Name of equipment	Technical specification	Designation of equipment / covered themes	Module(s) in which the equipment is used	Comments
1	Visual aids		Set of teaching and visual aids "Engineering graphics"	To model electric circuits with use of the software	
2	Visual aids		Models of geometrical figures for graphical works	To model electric circuits with use of the software	
3	Drawing tools		calipers, stangenreismus, micrometer, nutrometer	To model electric circuits with use of the software	
4	Visual aids		Legend for electric circuits	To model electric circuits with use of the software	
5	Technical device		Personal computer	To model electric circuits with use of the software	
6	Computer software		Graphical software "Archicad", "Autocad"	To model electric circuits with use of the software	
7	Computer software		Graphical software "Archicad", "Autocad"	To model electric circuits with use of the software	
8	Computer software		Graphical program "Compas"	To model electric circuits with use of the software	

9	Laboratory stand "Electric technics and basics of electronics" (ET and BE-SC)	Power: ~220/127 V, 50Hz	Laboratory practical works	To analyse electric systems, electronic technique and control their functions	
10	Modeling of transition processes in electrical power systems with MPSO of NTC-10.72 	The laboratory stand is intended for use as the educational equipment in the highest and average special educational institutions when holding laboratory occupations.	1. A research of the modes and static stability of the elementary electrical system by means of electrodynamic model. 2. A research of influence of types of short circuit on dynamic stability of system of an electricity transmission by means of electrodynamic model. 3. An asynchronous mode in the elementary electrical system. 4. Removal of characteristics of the mode of the elementary electrical system from two stations of commensurable capacities.	To analyze electric systems, the electronic equipment and control its functions	
11	Standard set of the educational equipment "Electrotechnical Materials", execution desktop, the computer version (without personal computer), ELCUT student's ETM-NK-S (without personal computer)		Demonstration, Carrying out laboratory – practical works	Analysing electric systems, electronic technics and control its functions	
12	Laboratory stand "Electric technics and basics of electronics" (ET and BE-SC)	Power: ~220/127 V, 50Hz	Laboratory –practical works	Analysing electric systems, electronic technics and control its functions	
13	Electric measurements with MPSO	Power: ~220/127 V, 50Hz Consumed capacity, kW not more than: 0.8	1. Study of analog measuring instruments. 2. Extension of limits of measurement, calculation of additional resistance and shunts.	Analysing electric systems, electronic technics and control its functions	

			<p>3. Signal amplitude measurement.</p> <p>4. Measurement of parameters of elements of electric circuits by method of the voltmeter and ampermeter.</p> <p>5. Measurement of parameters of elements of electric circuits by a bridge method</p> <p>6. Measurement of parameters of elements of electric circuits by a resonant method</p> <p>7. Measurement of deformation, temperature (tensoresistor and thermoresistor, thermocouple).</p> <p>8. Study of a digital oscillograph.</p> <p>9. A study on the basis of a measuring complex of the digital logger.</p> <p>10. Measurement of power.</p> <p>11. Measurement of frequency and intervals of time.</p> <p>12. Phase shift measurement.</p>		
14	Electric measurements	Power : 3~220/127 V, 50Hz Consumed capacity, kW not more: 0,2 embedded load; 1,5 external load	<p>1. Checking technical ampermeter of magnet electrical system.</p> <p>2. Checking voltmeter of a magnet electrical system.</p> <p>3. Checking the wattmeter of electric dynamic system.</p> <p>4. Checking of the single-phase counter of electrical energy of induction system.</p> <p>5. Extension of limits of measurement of the ampermeter.</p> <p>6. Extension of limits of measurement of voltmeters.</p> <p>7. Measurement of resistance by an indirect method.</p> <p>8. Measurement of electrical power factor of $\cos(\varphi)$ in case of different types of loadings.</p> <p>9. Inductivity measurement by an indirect way.</p> <p>10. Measurement of the active power in 3 phase circuits.</p> <p>11. Measurement of tension, currents and frequencies by means of an electronic oscillograph.</p>	Analysing electric systems, electronic technics and control its functions	
15	Electric measurements with MPSO	Power : 3~220/127 VB, 50Hz Consumed	<p>1. Study of analog measuring instruments.</p> <p>2. Extension of limits of measurement, calculation</p>	Analysing electric systems, electronic technics and control its functions	

		power, kW not more than: 0.8	<p>of additional resistance and shunts.</p> <p>3. Signal amplitude measurement.</p> <p>4. Measurement of parameters of elements of electric circuits by method of the voltmeter and ampermeter.</p> <p>5. Measurement of parameters of elements of electric circuits by a bridge method</p> <p>6. Measurement of parameters of elements of electric circuits by a resonant method</p> <p>7. Measurement of deformation, temperature (tensoresistor and thermoresistor, thermocouple).</p> <p>8. Study of a digital oscillograph.</p> <p>9. A study on the basis of a measuring complex of the digital logger.</p> <p>10. Measurement of power.</p> <p>11. Measurement of frequency and intervals of time.</p> <p>12. Phase shift measurement.</p>		
16	Electric measurements	<p>P o w e r : 3~220/127 V, 50Hz</p> <p>C o n s u m e d power, kW not more than: 0,2 imbedded load; 1,5 external load</p>	<p>1. Checking of the technical ampermeter of magnetoelectric system.</p> <p>2. Checking of the voltmeter of magnetoelectric system.</p> <p>3. Checking of the active power meter of electrodynamic system.</p> <p>4. Checking of the single-phase counter of electrical energy of induction system.</p> <p>5. Extension of limits of measurement of the ampermeter.</p> <p>6. Extension of limits of measurement of voltmeters.</p> <p>7. Measurement of resistance by an indirect method.</p> <p>8. Measurement of electrical power factor of $\cos(\varphi)$ in case of different types of loadings.</p> <p>9. Inductivity measurement by an indirect way.</p> <p>10. Measurement of the active power in 3 phase circuits.</p> <p>11. Measurement of tension, currents and frequencies by means of an electronic oscillograph.</p>	Analysing electric systems, electronic technics and control its functions	

17	Laboratory stand "Electric machines and electric drive"	Network: 3 ~ 50 Hz 220B 3P+N (three-phase the four-wire with the working zero conductor with the linear stress 220 and with a frequency of 50 Hz) Power consumption: 500 W It is constructive the bench consists of the casing in which an electric equipment, electronic boards, a front panel and a table-top of the integrated desktop is set. In the casing of the bench are placed: • board of rectifiers; • module of the termination resistors; • three-phase laboratory autotransformer (0,48 kVA); • the three-phase researched transformer (0,3 kVA).	The bench is intended for holding laboratory researches at the rate "Electrical machines". A research of properties of a direct current generator with parallel and independent excitation; the three-phase asynchronous electromotor with a short-circuited rotor and the engine of a direct current with independent excitation in motive and the brake modes, regulation of rotating speed of engines. List of laboratory operations: 1. Laboratory operation No. 6 "A research three-phase ASYNCHRONIC ENGINE with a short-circuited rotor"; 2. Laboratory operation No. 7 "Research GPT with parallel and independent excitation"; 3. Laboratory operation No. 8 "Research DIRECT CURRENT ENGINE with parallel excitation"; 4. Laboratory operation No. 9 "A research ASYNCHRONIC ENGINE with κ.3. a rotor in the mode generating without return of energy in a network (DT)"; 5. Laboratory operation No. 10 "A research ASYNCHRONIC ENGINE with κ.3. a rotor in the mode generating with return of energy in a network (recuperative braking)"; 6. Laboratory operation. No. 11 "Research DIRECT CURRENT ENGINE in the DT mode"; 7. Laboratory operation. No. 12 "Regulation of speed of DIRECT CURRENT ENGINE with independent excitation".	Diagnose electric machines and transformers	
18	Laboratory stand "Electrical Machines and Electric Drive"	Network: 3 ~ 50 Hz 220B 3P+N (three-phase the four-wire with the working zero conductor with the linear stress 220 and with a frequency of 50 Hz) Power consumption: 500 W It is constructive	The bench is intended for holding laboratory researches at the rate "Electrical machines". A research of properties of a direct current generator with parallel and independent excitation; the three-phase asynchronous electromotor with a short-circuited rotor and the engine of a direct current with independent excitation in motive and the brake modes, regulation of rotating speed of	Diagnose electric machines and transformers	

		<p>the bench consists of the casing in which an electric equipment, electronic boards, a front panel and a table-top of the integrated desktop is set.</p> <p>In the casing of the bench are placed:</p> <ul style="list-style-type: none"> • board of rectifiers; • module of the termination resistors; • three-phase laboratory autotransformer (0,48 kVA); • the three-phase researched transformer (0,3 kVA). 	<p>engines. List of laboratory operations:</p> <ol style="list-style-type: none"> 1. Laboratory operation No. 6 "A research three-phase ASYNCHRONIC ENGINE with a short-circuited rotor"; 2. Laboratory operation No. 7 "Research GPT with parallel and independent excitation"; 3. Laboratory operation No. 8 "Research DIRECT CURRENT ENGINE with parallel excitation" 4. Laboratory operation No. 9 "A research ASYNCHRONIC ENGINE with $\kappa.3.$ a rotor in the mode generating without return of energy in a network (DT)" 5. Laboratory operation No. 10 "A research ASYNCHRONIC ENGINE with $\kappa.3.$ a rotor in the mode generating with return of energy in a network (recuperative braking)". 6. Laboratory operation. No. 11 "Research DIRECT CURRENT ENGINE in the DT mode" 7. Laboratory operation. No. 12 "Regulation of speed of DIRECT CURRENT ENGINE with independent excitation". 		
19	<p>Laboratory stand "Asynchronous Electric Motor"</p>	<p>Network: 3 ~ 50 Hz 220B 3P+N (three-phase the four-wire with the working zero conductor with the linear stress 220 and with a frequency of 50 Hz)</p> <p>Power consumption: 1 kW</p> <p>In the casing of the bench are placed:</p> <p>the frequency transformer intended for formation of three-phase alternating current mains of adjustable</p>	<p>It is intended for a study of construction, the principle of operation, operating characteristics of the asynchronous engine with a short-circuited and phase rotor. The bench allows to carry out the following laboratory operations:</p> <p>Experimental determination of phases of windings of the stator of the asynchronous engine.</p> <ol style="list-style-type: none"> 1. Research of the three-phase asynchronous engine by an idling method. 2. Research of the three-phase asynchronous engine by method of short circuit. 3. Research of natural mechanical and electromechanical characteristics of the asynchronous engine. 	<p>Diagnose electric machines and transformers</p>	

19	Лабораторный стенд "Асинхронный электродвигатель"	<p>frequency and tension;</p> <ul style="list-style-type: none"> • static load the module the asynchronous engine; • the measuring system intended for measurement and display of the researched engine parameters (current, tension, electric power, speed, the mechanical moment). <p>On a front panel of the bench are placed:</p> <ul style="list-style-type: none"> • governing bodies of the inverter; • governing bodies of a node of a static load; • controls of the start regulating equipment; • indicators of system of measurement; • switching oppression; • The USB connector for connection of the PC. <p>Program and methodical support is applied to the laboratory bench:</p> <ul style="list-style-type: none"> • the set of methodical and technical documentation intended for teachers; • the software for operation with the stand. 	<p>4. Research of operating characteristics of the engine.</p> <p>5. A research of artificial mechanical and electromechanical characteristics of the engine in case of change of parameters of a power line.</p> <p>6. A research of artificial mechanical and electromechanical characteristics of the engine in case of introduction of additional resistance to a rotor circuit.</p> <p>The laboratory works performed only in the dialog mode with the PC:</p> <ol style="list-style-type: none"> 1. Research of rheostatic launch of the three-phase asynchronous engine. 2. A research of launch of the three-phase asynchronous engine at the under tension. 3. Research of launch of the three-phase asynchronous engine switching of the connection circuit of a winding of the stator. 		
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20	Laboratory stand "Synchronous Electric Motor and Generator"	<p>Network: 3 ~ 50 Hz 220B 3P+N (three-phase the four-wire with the working zero conductor with the linear stress 220 and with a frequency of 50 Hz) Power consumption: 1 kW In the casing of the bench are placed:</p> <ul style="list-style-type: none"> • the pulse-width transformer intended for engine management of the direct current working in the mode of the drive engine and a static load; • the module of three-phase adjustable loading intended for creation of the resistive or active and inductive load for the synchronous generator; • the measuring system intended for measurement and display of the researched engine/generator parameters (current, tension, electric power, speed, the mechanical moment). <p>On a front panel of the bench are placed:</p> <ul style="list-style-type: none"> • governing bodies of the engine of a direct current; • governing bodies of the 	<p>The educational laboratory bench is intended for a study of construction, the principle of operation, operating characteristics of the synchronous motor and the synchronous generator. The bench allows to carry out the following laboratory operations:</p> <ol style="list-style-type: none"> 1. Research of a no-load characteristic of the synchronous generator. The experimental receiving a no-load characteristic ($E_0=f(I_B)$) the synchronous generator. 2. Research of short-circuit characteristic of the synchronous generator. The experimental obtaining short-circuit characteristic ($I_K=f(I_B)$) of the synchronous generator. 3. A research of external characteristics of the synchronous generator in case of different types of loading. The experimental receiving external characteristics ($U_1=f(I_1)$) the synchronous generator. 4. A research of regulation curves of the synchronous generator in case of different types of loading. The experimental obtaining regulation curves ($I_B=f(I_1)$) of the synchronous generator. 5. Connection to a network of the synchronous generator. Obtaining the experimental skills of connection of the synchronous generator to a network by method of exact synchronization. 6. Research of U-shaped characteristics of the synchronous generator. The experimental obtaining U-shaped characteristics ($I_1=f(I_B)$) of the synchronous generator. 7. Research of angular characteristics of the synchronous generator.. 	Diagnose electric machines and transformers	
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20	Лабораторный стенд "Синхронный электродвигатель и генератор"	<p>engine of the synchronous generator;</p> <ul style="list-style-type: none"> • controls of the start regulating equipment; • governing bodies of three-phase adjustable loading; • indicators of system of measurement; • switching oppression; • The USB connector for connection of the PC. 	<p>The experimental obtaining angular characteristics ($P_1=f(\square)$) of the synchronous generator.</p> <p>8. Research of the mechanical characteristic of the synchronous motor. The experimental obtaining the mechanical characteristic ($n=f(M)$) of the synchronous motor.</p> <p>9. Research of operating characteristics of the synchronous motor. The experimental receiving operating characteristics ($M=f(P_2)$, $P=f(P_2)$, $I=f(P_2)$) of the synchronous motor.</p> <p>10. Research of the U-shaped characteristic of the synchronous motor. The experimental obtaining U-shaped characteristics ($n=f(M)$) of the synchronous motor.</p> <p>11. Research of angular characteristics of the synchronous motor. The experimental obtaining angular characteristics ($P_1=f(\square)$) of the synchronous motor.</p>	Диагностировать электрические машины и трансформаторы	
22	Laboratory stand "Transformers"	<p>Network: ~ 50 Of Hz 220B (single-phase 220B 50 Hz) Power consumption: 0,5 kW</p> <ul style="list-style-type: none"> • governing bodies of a node of a static load; • controls of the start regulating equipment; • indicators of system of measurement; • switching oppression; • The USB connector for connection of the PC. <p>Program and methodical support is applied</p>	<p>The educational laboratory stand is intended for studying of a design, the principle of operation of the three-phase transformer. The stand allows to carry out the following laboratory works:</p> <ol style="list-style-type: none"> 1. Research of the single-phase transformer by an idling method. 2. Research of the single-phase transformer by method of short circuit. 3. A research of external characteristics of the three-phase transformer during the work on different types of loading. 4. Skilled definition of groups of connection of the three-phase transformer by a voltmeter method. 5. A research of parallel 	Diagnose electric machines and transformers	

		to the laboratory bench: • the set of methodical and technical documentation intended for teachers; • the software for operation with the bench	operation operation of three-phase transformers at equal values of parameters of transformers. 6. A research of parallel operation of three-phase transformers at various values of parameter of coefficient of transformation. 7. A research of parallel operation of three-phase transformers at various values of parameter of tension of short circuit.		
22	Laboratory stand "Asynchronous Electric Motor"	Network: 3~50 Hz 220B 3P+N (three-phase the four-wire with the working zero conductor with the linear stress 220 and with a frequency of 50 Hz) Power consumption: 1 kW In the casing of the bench are placed: • the frequency transformer intended for formation of three-phase alternating current mains of adjustable frequency and tension; • static load the module the asynchronous engine; • the measuring system intended for measurement and display of the researched engine parameters (current, tension, electric power, speed, the mechanical moment).	It is intended for a study of construction, the principle of operation, operating characteristics of the asynchronous engine with a short-circuited and phase rotor. The bench allows to carry out the following laboratory operations: Experimental determination of phases of windings of the stator of the asynchronous engine. 1. Research of the three-phase asynchronous engine by an idling method. 2. Research of the three-phase asynchronous engine by method of short circuit. 3. Research of natural mechanical and electromechanical characteristics of the asynchronous engine. 4. Research of operating characteristics of the engine. 5. A research of artificial mechanical and electromechanical characteristics of the engine in case of change of parameters of a power line. 6. A research of artificial mechanical and electromechanical characteristics of the engine in case of introduction of additional resistance to a rotor circuit. The laboratory works performed only in the dialog	Diagnose electric machines and transformers	

		<p>On a front panel of the bench are placed:</p> <ul style="list-style-type: none"> • governing bodies of the inverter; • governing bodies of a node of a static load; • controls of the start regulating equipment; • indicators of system of measurement; • switching oppression; • The USB connector for connection of the PC. <p>Program and methodical support is applied to the laboratory bench:</p> <ul style="list-style-type: none"> • the set of methodical and technical documentation intended for teachers; • the software for operation with the bench.. 	<p>mode with the PC:.</p> <ol style="list-style-type: none"> 1. Research of rheostatic launch of the three-phase asynchronous engine. 2. A research of launch of the three-phase asynchronous engine at the under tension. 3. Research of launch of the three-phase asynchronous engine switching of the connection circuit of a winding of the stator 		
23	Laboratory stand "Synchronous Electric Motor and Generator"	<p>Network: 3 ~ 50 Hz 220B 3P+N (three-phase the four-wire with the working zero conductor with the linear stress 220 and with a frequency of 50 Hz) Power consumption: 1 kW In the casing of the bench are placed:</p> <ul style="list-style-type: none"> • the pulse-width transformer intended for engine management of 	<p>The educational laboratory bench is intended for a study of construction, the principle of operation, operating characteristics of the synchronous motor and the synchronous generator. The bench allows to carry out the following laboratory operations:</p> <ol style="list-style-type: none"> 1. Research of a no-load characteristic of the synchronous generator. The experimental receiving a no-load characteristic ($E_0=f(I_B)$) the synchronous generator. 2. Research of short-circuit characteristic of the synchronous generator. The 	Diagnose electric machines and transformers	

	<p>the direct current working in the mode of the drive engine and a static load;</p> <p>the module of three-phase adjustable loading intended for creation of the resistive or active and inductive load for the synchronous generator;</p> <ul style="list-style-type: none"> the measuring system intended for measurement and display of the researched engine/generator parameters (current, tension, electric power, speed, the mechanical moment). <p>On a front panel of the bench are placed:</p> <ul style="list-style-type: none"> governing bodies of the engine of a direct current; governing bodies of the engine of the synchronous generator; controls of the start regulating equipment; governing bodies of three-phase adjustable loading; indicators of system of measurement; switching oppression; The USB connector for connection of the PC. 	<p>experimental obtaining short-circuit characteristic ($I_K = f(I_B)$) of the synchronous generator.</p> <p>3. A research of external characteristics of the synchronous generator in case of different types of loading. The experimental receiving external characteristics ($U_1 = f(I_1)$) the synchronous generator.</p> <p>4. A research of regulation curves of the synchronous generator in case of different types of loading. The experimental obtaining regulation curves ($I_B = f(I_1)$) of the synchronous generator.</p> <p>5. Connection to a network of the synchronous generator. Obtaining the experimental skills of connection of the synchronous generator to a network by method of exact synchronization.</p> <p>6. Research of U-shaped characteristics of the synchronous generator. The experimental obtaining U-shaped characteristics ($I_1 = f(I_B)$) of the synchronous generator.</p> <p>7. Research of angular characteristics of the synchronous generator. The experimental obtaining angular characteristics ($P_1 = f(\alpha)$) of the synchronous generator.</p> <p>8. Research of the mechanical characteristic of the synchronous motor. The experimental obtaining the mechanical characteristic ($n = f(M)$) of the synchronous motor.</p> <p>9. Research of operating characteristics of the synchronous motor. The experimental receiving operating characteristics ($M = f(P_2)$, $P = f(P_2)$, $I = f(P_2)$) the synchronous motor.</p>	
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			<p>10. Research of the U-shaped characteristic of the synchronous motor. The experimental obtaining U-shaped characteristics ($n=f(M)$) of the synchronous motor.</p> <p>11. Research of angular characteristics of the synchronous motor. The experimental obtaining angular characteristics ($P_1=f(\alpha)$) of the synchronous motor.</p>		
24	Laboratory stand "Transformers"	<p>Network: ~ 50 Of Hz 220B (single-phase 220B 50 Hz) Power consumption: 0,5 kW • governing bodies of a node of a static load;</p> <ul style="list-style-type: none"> • controls of the start-regulating equipment; • indicators of system of measurement; • switching oppression; • The USB connector for connection of the PC. Program and methodical support is applied to the laboratory bench: • the set of methodical and technical documentation intended for teachers; • the software for operation with the bench 	<p>The educational laboratory stand is intended for studying of a design, the principle of operation of the three-phase transformer.</p> <p>The stand allows to carry out the following laboratory works:</p> <ol style="list-style-type: none"> 2. Research of the single-phase transformer by an idling method. 3. Research of the single-phase transformer by method of short circuit. 4. A research of external characteristics of the three-phase transformer during the work on different types of loading. 5. Skilled definition of groups of connection of the three-phase transformer by a voltmeter method. 6. A research of parallel operation of three-phase transformers at equal values of parameters of transformers. 7. A research of parallel operation of three-phase transformers at various values of parameter of coefficient of transformation. 8. A research of parallel operation of three-phase transformers at various values of parameter of tension of short circuit. 	Diagnose electric machines and transformers	
25	Energy saving technologies. Electric power supply with MPSO NTC-10.49		<ol style="list-style-type: none"> 1. Research of energy characteristics of ASYNCHRONIC ENGINE and reasons for efficiency of use of the frequency converter. 2. Research of energy characteristics of the 	Maintain electric equipment and means of automation.	

			transformer and reasons for efficiency of redistribution of loadings.		
26	Automated control of the electric drive	Power: 3 ~ 220/127 V, 50 Hz Power consumption, kW no more: 0.5	<ol style="list-style-type: none"> 1. Launch of the engine of a direct current (DCE) as time. 2. Start-up of DIRECT CURRENT ENGINE as EMF. 3. Start-up of DIRECT CURRENT ENGINE as current. 4. Braking of DIRECT CURRENT ENGINE as EMF. 5. Braking of DIRECT CURRENT ENGINE as time. 6. Braking of DIRECT CURRENT ENGINE against switching on. 7. Launch of the asynchronous engine (AE) with a short-circuited rotor. 8. Braking against switching on ASYNCHRONIC ENGINE with a short-circuited rotor. 9. A reverse ASYNCHRONIC ENGINE with a short-circuited rotor. 10. Dynamic braking ASYNCHRONIC ENGINE with a short-circuited rotor as time. 11. Research of operation of the thyristor single-phase transformer. 12. Research of open-ended management system of DIRECT CURRENT ENGINE. 13. Research of closed management system of DIRECT CURRENT ENGINE. 	Maintain electric equipment and means of automation.	
27	Research of the scheme of management of climate in the greenhouse and a vegetable storehouse	Power: ~ 50 Of Hz 220B (single-phase 220B 50 Hz) Power consumption, kW no more: 0,3	<ol style="list-style-type: none"> 1. Research of the characteristic of the sensor of humidity. 2. Research of the characteristic of the sensor of temperature. 3. Research of devices of maintenance of temperature indoors. 4. Research of the air conditioning system. 5. Research of system of a drying and moistening of an air. 6. Studying of the scheme of 	Maintain electric equipment and means of automation.	

			management of temperature condition in a vegetable storehouse and in the greenhouse.		
28	Laboratory stand "Power Supply of Industrial Enterprises with MPSO"	<p>Network: 3 ~ 50 Hz 220B 3P+N (three-phase the four-wire with the working zero conductor with the linear stress 220 and with a frequency of 50 Hz) Power consumption: 300 W • power supply unit ± 15 B 1 And, +5 V 1 A;</p> <ul style="list-style-type: none"> • a stop watch board with resolution capability 0,1 with; • board of the thyristor voltage controller (TVC); • control boards for switching of the researched circuits of the current protection of the electromotor and transformer; • board of the termination resistors MLT-2 of 100 Ohms; • unit of glow lamps ~ 220 V 15 W, 6 lamps; • unit of the RP-18 relay, 8 relays; • power transformer OCM1-0,1. 	<p>The laboratory stand is held for use as the educational equipment when holding laboratory classes in studying of separate types of electric equipment used in case of power supply of industrial enterprises.</p> <p>/ 1. Research of schemes of inclusion of secondary windings of transformers of current. Research object: the current transformers which are switched on in 3 phase network. Schemes of connection of the secondary windings of the transformer of current used in devices of relay protection and automatic equipment are studied.</p> <p>1. 2. Testing of the maximum current protection using the induction current relay. Research object: RT-84 current relay. The device and operation of the induction relay, feature of its application for protection, merits and demerits are studied.</p> <p>2. 3. A research of operating modes of a power line of alternating current in case of change of power factor of loading. Research object: the power line model loaded on active and inductive loading. In laboratory work line operating modes in case of change of power factor of loading are researched, calculation of the compensating condenser is made and the experiment on compensation of jet capacity is made.</p> <p>3. 4. Testing of relay protection of the high-voltage electric motor. Research object: model of the scheme of relay protection. In work it is required to study, adjust and test in practice work of system of protection at the operating stand.</p>	Provides and maintains the agricultural production with electric power	

		.	4. 5. Testing of relay protection of the lowering transformer. Research object: model of the scheme of relay protection. In work it is required to study and test in practice work of system of protection of the power transformer at the operating stand.		
29	Laboratory set of the "Quality of Electric Energy in Systems of Power Supply with MPSO"	Network: 3 ~ 50 Hz 380B 3P+N (three-phase the four-wire with the working zero conductor with the linear stress 380 and with a frequency of 50 Hz) Power consumption: 300 W Software: An oscillograph In the casing of the bench are placed: • step-down transformers; • board of the thyristor voltage controller (TVC); • unit of the termination resistors; • unit of condensers; • chokes; • unit of glow lamps ~ 220 V 15 W, 15 lamps; • the force autotransformer on the basis of OCM1-0,1; • module of a microprocessor measuring system	1. The laboratory bench is intended for use as the educational equipment when carrying out laboratory occupations on disciplines of "A basis of electrical power supply of the industrial enterprises", "Electrical systems and networks", etc. An object of a research is the power line model loaded on the active and inductive loading with a possibility of connection of the compensating condensers. Measurement of figures of merit of electrical energy by means of the personal computer. 2. Determination of influence of a voltage deviation on the power consumed by loading. 3. Counter load voltage control 4. Voltage regulation by a cross reactive power compensation by means of the capacitor battery. 5. Voltage regulation by a longitudinal reactive power compensation by means of the capacitor battery 6. Lowering of level of generation of the higher harmonics of current by changeover of the half-wave rectifier on double-wave in a loading feed circuit a direct current. 7. Compensating of the higher harmonics of current with the help the filter of the compensating device.	Provides and maintains the agricultural production with electric power	
30	Educational set of the Power Supply of Industrial Enterprises laboratory equipment	Power consumption, 500 V • And, Power supply: from three-phase alternating current mains	It is intended for carrying out laboratory occupations in institutions initial professional, average professional and higher education, for obtaining basic and profound professional knowledge, and skills / the Set.	Provides and maintains the agricultural production with electric power	

		<p>with working zero and protective conductors tension, 380 V, frequency, 50 Hz</p> <p>Working stress, 12 V</p> <p>Class of protection against defeat by an electric current of I</p>	<p>electric equipment operation modes</p> <ol style="list-style-type: none"> 1. A research of operation modes of an electric equipment in case of the symmetrical load. 2. A research of operation modes of an electric equipment in case of the asymmetrical loading. 3. A research of influence of load of losses of electrical energy in system of electrical power supply. 4. Research of influence of character of load of an electric equipment operation mode. 5. A research of the mode of a reactive power compensation by means of the capacitor battery. 6. A research of influence of parameters and the diagram of switching on of the capacitor battery on an electric equipment operation mode. <p>Transient phenomena</p> <ol style="list-style-type: none"> 1. Electromagnetic transient phenomena in case of the symmetric short circuits in system of electrical power supply. 2. Electromagnetic transient phenomena in case of the asymmetrical short circuits in system of electrical power supply. 3. A research of the factors influencing values of short-circuit currents in system of electrical power supply. <p>Relay protection and automatic equipment</p> <ol style="list-style-type: none"> 1. Maximum current protection of the power line 2. Differential protection of the power line 3. Maximum current protection of the transformer. 4. Differential protection of the transformer. 5. Automatic repeated switching on of the power line. 6. Automatic repeated switching on of the transformer. 7. Automatic switching on of a reserve of the feeding association. 	
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31	<p>Energy saving technologies. Power supply with MPSO NTC-10.49</p> 	<p>The stand allows to carry out laboratory works on studying of methods of energy saving in power supply of the entity.</p>	<p>Research of energy characteristics ASYNCHRONIC ENGINE and reasons for efficiency of use of the frequency converter. Research of energy characteristics of the transformer and reasons for efficiency of redistribution of loadings. Reasons for feasibility of compensation of jet capacity by power transmission. Research of efficiency of compensation of jet capacity on primary and secondary party of the feeding transformer. Research of efficiency of compensation of jet capacity by means of batteries of condensers. Research of efficiency of compensation of jet capacity by means of SD. Reasons for feasibility of control of the compensating devices. Research of influence of semiconductor converters on quality of the feeding tension and power factor. Research of influence of quality of the feeding tension on characteristics of consumers. Reasons for feasibility of regulation of power factor of lighting installations. Research of energy efficiency of various sources of an electric lighting</p>		
32	<p>Distributive networks of systems of power supply with MPSO NTC-10.67</p> 	<p>The laboratory stand is held for use as the educational equipment when holding laboratory classes in disciplines "Bases of power supply of industrial enterprises", "Electric systems and networks", etc.</p>	<p>Measurement of parameters of the set transformer operation mode. Measurement of parameters of the set power line operation mode. Measurement of parameters of the set operation mode, an open-ended distributive electrical network. Influence of a reactive power compensation by means of the capacitor battery on parameters of the set operation mode, an open-ended distributive electrical network.</p>		

			Research of direct current characteristic of power on capacitor bank tension.		
33	Automated control of electric motor drive	Power: 3~220/127 V, 50Hz Consumed power, kW not more than: 0.5	<ol style="list-style-type: none"> 1. Launch of the engine of a direct current (EDC) as time. 2. Start-up of DIRECT CURRENT ENGINE as EMF. 3. Start-up of DIRECT CURRENT ENGINE as current. 4. Braking of DIRECT CURRENT ENGINE as EMF. 5. Braking of DIRECT CURRENT ENGINE as time. 6. Braking of DIRECT CURRENT ENGINE countercurrent. 7. Launch of the asynchronous engine (AE) with a short-circuited rotor. 8. Countercurrent braking ASYNCHRONIC ENGINE with a short-circuited rotor. 9. A reverse ASYNCHRONIC ENGINE with a short-circuited rotor. 10. Dynamic braking ASYNCHRONIC ENGINE with a short-circuited rotor as time. 11. Research of operation of the thyristor single-phase transformer. 12. Research of open-ended management system of DIRECT CURRENT ENGINE. 13. Research of closed management system of DIRECT CURRENT ENGINE 	Maintain electric equipment and means of automation	
34	Research of the scheme of management of climate in the greenhouse and a vegetable storehouse	Power: ~50Hz 220V (one-phase 220V 50Hz) Consumed power, kW not more than: 0,3	<ol style="list-style-type: none"> 1. Research of the characteristic of the sensor of humidity. 2. Research of the characteristic of the sensor of temperature. 3. Research of devices of maintenance of temperature indoors. 4. Research of the air conditioning system. 5. Research of system of an osushka and moistening of air. 6. Studying of the scheme of management of temperature condition in a vegetable storehouse and in the greenhouse. 	Maintain electric equipment and means of automation	

35	Research of centrifugal and axial fans with MPSO	Power: 1~220 V, 50Hz Consumed power, kW not more than: 0,5	1. Removal of the universal characteristic of the centrifugal fan. 2. Removal of the universal characteristic of the axial fan. 3. Research of consecutive operation of axial fans. 4. Research of parallel operation of axial fans.	Maintain electric equipment and means of automation	
36	Research of centrifugal and axial fans with MPSO	Power: 1~220 V, 50Hz Consumed power, kW not more than: 0,5	1. Removal of the universal characteristic of the centrifugal fan. 2. Removal of the universal characteristic of the axial fan. 3. Research of consecutive operation of axial fans. 4. Research of parallel operation of axial fans.	Maintain electric equipment and means of automation	
37	Visual aids		Models of geometrical figures for graphical works	Introduce the norms of standardization and metrology in the processes of agriculture production	
38	Electrical measurements	Power: 3~220/127 V, 50Hz Consumed power, kW not more than: 0,2 imbedded load; 1,5 external load	1. Checking of the technical ampermeter of magnetoelectric system. 2. Checking of the voltmeter of magnetoelectric system. 3. Checking of the active power meter of electrodynamic system. 4. Checking of the single-phase counter of electrical energy of induction system. 5. Extension of limits of measurement of the ampermeter. 6. Extension of limits of measurement of voltmeters. 7. Measurement of resistance by an indirect method. 8. Measurement of electrical power factor of $\cos(\varphi)$ in case of different types of loadings. 9. Inductivity measurement by an indirect way. 10. Measurement of the active power in 3 phase circuits. 11. Measurement of tension, currents and frequencies by means of an electronic oscillograph.	Introduce the norms of standardization and metrology in the processes of agriculture production	
39	Electric measurements with MPSO	Power: 3~220/127 V, 50Hz Consumed power, kW not more than: 0.8	1. Study of analog measuring instruments. 2. Extension of limits of measurement, calculation of additional resistance and shunts	Introduce the norms of standardization and metrology in the processes of agriculture production	


			<p>3. Signal amplitude measurement.</p> <p>4. Measurement of parameters of elements of electric circuits by method of the voltmeter and ampermeter.</p> <p>5. Measurement of parameters of elements of electric circuits by a bridge method</p> <p>6. Measurement of parameters of elements of electric circuits by a resonant method</p> <p>7. Measurement of deformation, temperature (tensoresistor and thermoresistor, thermocouple).</p> <p>8. Study of a digital oscillograph.</p> <p>9. A study on the basis of a measuring complex of the digital logger.</p> <p>10. Measurement of power.</p> <p>11. Measurement of frequency and intervals of time.</p> <p>12. Phase shift measurement.</p>		
40	Set of fertilizers		Demonstration, practical works	Master the basics of agronomy and cattle breeding	
41	Samples of grain cultures		Demonstration	Master the basics of agronomy and cattle breeding	
42	Samples of forage grass, multi-year crops and cereals		Demonstration, Laboratory works	Master the basics of agronomy and cattle breeding	
43	Skeletons of domestic animals		Demonstration	Master the basics of agronomy and cattle breeding	
44	Agricultural tools		Demonstration	Master the basics of agronomy and cattle breeding	
45	Automated control of electric drive	<p>P o w e r : 3~220/127 V, 50Hz Consumed power, kW not more than: 0.5</p>	<p>1. Launch of the engine of a direct current (EDC) as time.</p> <p>2. Start-up of DIRECT CURRENT ENGINE as EMF.</p> <p>3. Start-up of DIRECT CURRENT ENGINE as current.</p> <p>4. Braking of DIRECT CURRENT ENGINE as EMF.</p> <p>5. Braking of DIRECT CURRENT ENGINE as time.</p> <p>6. Braking of DIRECT CURRENT ENGINE countercurrent.</p>	<p>Master the basics of agronomy and cattle breeding</p> <p>Maintain electric equipment and means of automation</p>	




			<p>7. Launch of the asynchronous engine (AE) with a short-circuited rotor.</p> <p>8. Countercurrent braking ASYNCHRONIC ENGINE with a short-circuited rotor.</p> <p>9. A reverse ASYNCHRONIC ENGINE with a short-circuited rotor.</p> <p>10. Dynamic braking ASYNCHRONIC ENGINE with a short-circuited rotor as time.</p> <p>11. Research of operation of the thyristor single-phase transformer.</p> <p>12. Research of open-ended management system of DIRECT CURRENT ENGINE.</p> <p>13. Research of closed management system of DIRECT CURRENT ENGINE</p>		
46	Research of the scheme of management of climate in the greenhouse and a vegetable storehouse	Power: ~50Hz 220V (one-phase 220V 50Hz) Consumed power, kW not more than: 0,3	<p>1. Research of the characteristic of the sensor of humidity.</p> <p>2. Research of the characteristic of the sensor of temperature.</p> <p>3. Research of devices of maintenance of temperature indoors.</p> <p>4. Research of the air conditioning system.</p> <p>5. Research of system of an osushka and moistening of air.</p> <p>6. Studying of the scheme of management of temperature condition in a vegetable storehouse and in the greenhouse..</p>	Maintain electric equipment and means of automation	
47	Research of centrifugal and axial fans with MPSO	Power: 1~220 V, 50Hz Consumed power, kW not more than: 0,5	<p>1. Removal of the universal characteristic of the centrifugal fan.</p> <p>2. Removal of the universal characteristic of the axial fan.</p> <p>3. Research of consecutive operation of axial fans.</p> <p>4. Research of parallel operation of axial fans..</p>	Maintain electric equipment and means of automation	
48	Standard set of the educational equipment "Consumers of Electric Energy"		The stand is completed with the measuring instrument of parameters of the power supply network and a digital oscillograph. • The stand allows to remove curves of current and stress at the time of connection of various loadings to network.	Maintain electric equipment and means of automation	

			<ul style="list-style-type: none"> • The stand allows to make the analysis of harmonic components of tension of network to the 30th harmonica. • The stand allows to record the measured data. <p>Represents the educational set consisting of set of the consumers of electric energy possessing various characteristics:</p> <ol style="list-style-type: none"> 1. Various active power. 2. Various jet power. 3. Various KPI. 4. Various parameters of the starting modes. 5. Various functions of energy saving. 		
49	Laboratory stand "Power Supply of Industrial Enterprises with MPSO"	<p>Network: 3 ~ 50 Hz 220B 3P+N (three-phase the four-wire with the working zero conductor with the linear stress 220 and with a frequency of 50 Hz) Power consumption: 300 W • power supply unit ±15 B 1 And, +5 V 1 A;</p> <ul style="list-style-type: none"> • a stop watch board with resolution capability 0,1 with; • board of the thyristor voltage controller (TVC); • control boards for switching of the researched circuits of the current protection of the electromotor and transformer; • board of the termination resistors MLT-2 of 100 Ohms; • unit of glow 	<p>The laboratory stand is held for use as the educational equipment when holding laboratory classes in studying of separate types of electric equipment used in case of power supply of industrial enterprises.</p> <p>/ 1. Research of schemes of inclusion of secondary windings of transformers of current. Research object: the current transformers which are switched on in 3 phase network. Schemes of connection of the secondary windings of the transformer of current used in devices of relay protection and automatic equipment are studied. 2. Testing of the maximum current protection using the induction current relay. Research object: RT-84 current relay. The device and operation of the induction relay, feature of its application for protection, merits and demerits are studied. 3. A research of operating modes of a power line of alternating current in case of change of power factor of loading. Research object: the power line model loaded on active and inductive loading. In laboratory work line operating modes in case of change of power factor of loading are</p>	Maintain and provide power supply	

		<p>lamps ~ 220 V 15 W, 6 lamps;</p> <ul style="list-style-type: none"> • unit of the RP-18 relay, 8 relays; • power transformer OCM1-0,1. 	<p>researched, calculation of the compensating condenser is made and the experiment on compensation of jet capacity is made.</p> <p>4. Testing of relay protection of the high-voltage electric motor. Research object: model of the scheme of relay protection. In work it is required to study, adjust and test in practice work of system of protection at the operating stand.</p> <p>5. Testing of relay protection of the lowering transformer. Research object: model of the scheme of relay protection. In work it is required to study and test in practice work of system of protection of the power transformer at the operating stand.</p>		
50	<p>Laboratory stand "Quality of Electric Energy in Systems of Power Supply with MPSO"</p>	<p>Network: 3 ~ 50 Hz 380B 3P+N (three-phase the four-wire with the working zero conductor with the linear stress 380 and with a frequency of 50 Hz) Power consumption: 300 W</p> <p>Software: An oscillograph In the casing of the bench are placed:</p> <ul style="list-style-type: none"> • step-down transformers; • board of the thyristor voltage controller (TVC); • unit of the termination resistors; • unit of condensers; • chokes; • unit of glow lamps ~ 220 V 15 W, 15 lamps; • the force autotransformer 	<p>1. The laboratory bench is intended for use as the educational equipment when carrying out laboratory occupations on disciplines of "A basis of electrical power supply of the industrial enterprises", "Electrical systems and networks", etc. An object of a research is the power line model loaded on the active and inductive loading with a possibility of connection of the compensating condensers. Measurement of figures of merit of electrical energy by means of the personal computer.</p> <p>2. Determination of influence of a voltage deviation on the power consumed by loading.</p> <p>3. Counter load voltage control</p> <p>4. Voltage regulation by a cross reactive power compensation by means of the capacitor battery.</p> <p>5. Voltage regulation by a longitudinal reactive power compensation by means of the capacitor battery</p> <p>6. Lowering of level of generation of the higher harmonics of current by changeover of the half-wave</p>	<p>Maintain and provide power supply</p>	

		on the basis of OCM1-0,1; • module of a microprocessor measuring system	rectifier on double-wave in a loading feed circuit a direct current. 7. Compensating of the higher harmonics of current with the help the filter of the compensating device.		
51	Educational set of the Power Supply of Industrial Enterprises laboratory equipment	P o w e r consumption, 500 V • And, Power supply: from three-phase alternating current mains with working zero and protective conductors tension, 380 V, frequency, 50 Hz Working stress, 12 V Class of protection against defeat by an electric current of I	It is intended for carrying out laboratory occupations in institutions initial professional, average professional and higher education, for obtaining basic and profound professional knowledge, and skills / the Set electric equipment operation modes 1. A research of operation modes of an electric equipment in case of the symmetrical load. 2. A research of operation modes of an electric equipment in case of the asymmetrical loading. 3. A research of influence of load of losses of electrical energy in system of electrical power supply. 4. Research of influence of character of load of an electric equipment operation mode. 5. A research of the mode of a reactive power compensation by means of the capacitor battery. 6. A research of influence of parameters and the diagram of switching on of the capacitor battery on an electric equipment operation mode. Transient phenomena 1. Electromagnetic transient phenomena in case of the symmetric short circuits in system of electrical power supply. 2. Electromagnetic transient phenomena in case of the asymmetrical short circuits in system of electrical power supply. 3. A research of the factors influencing values of short-circuit currents in system of electrical power supply.	Maintain and provide power supply	

			<p>Relay protection and automatic equipment</p> <ol style="list-style-type: none"> 1. Maximum current protection of the power line 2. Differential protection of the power line 3. Maximum current protection of the transformer. 4. Differential protection of the transformer. 5. Automatic repeated switching on of the power line. 6. Automatic repeated switching on of the transformer. 7. Automatic switching on of a reserve of the feeding association. 		
52	<p>E n e r g y s a v i n g technologies. Power supply with MPSO NTTs-10.49</p> 	<p>The stand allows to carry out laboratory works on studying of methods of energy saving in power supply of the entity.</p>	<p>Research of energy characteristics HELL and reasons for efficiency of use of the frequency converter.</p> <p>Research of energy characteristics of the transformer and reasons for efficiency of redistribution of loadings.</p> <p>Reasons for feasibility of compensation of jet capacity by power transmission.</p> <p>Research of efficiency of compensation of jet capacity on primary and secondary party of the feeding transformer.</p> <p>Research of efficiency of compensation of jet capacity by means of batteries of condensers.</p> <p>Research of efficiency of compensation of jet capacity by means of SD.</p> <p>Reasons for feasibility of control of the compensating devices.</p> <p>Research of influence of semiconductor converters on quality of the feeding tension and power factor.</p> <p>Research of influence of quality of the feeding tension on characteristics of consumers.</p> <p>Reasons for feasibility of regulation of power factor of lighting installations. Research of energy efficiency of various sources of an electric lighting</p>	<p>Maintain and provide power supply</p>	


53	Distributive networks of systems of power supply with MPSONTTs-10.67 	The laboratory stand is held for use as the educational equipment when holding laboratory classes in disciplines "Bases of power supply of industrial enterprises", "Electric systems and networks", etc.	1. Measurement of parameters of the set transformer operation mode. 2. Measurement of parameters of the set power line operation mode. 3. Measurement of parameters of the set operation mode, an open-ended distributive electrical network. 4. Influence of a reactive power compensation by means of the capacitor battery on parameters of the set operation mode, an open-ended distributive electrical network. 5. Research of direct current characteristic of power on capacitor bank tension.	Automate and mechanise the production processes	
54	 Standard set of the educational equipment "Instrumentations and Automatic Equipment", execution bench computer, Automation and Instrumentation -SK 	Overall dimensions 1400x1350x750 Weight, no more than 50 kg Technical characteristics Supply voltage of 220 V Frequency of supply voltage is 50 Hz Power consumption, no more than 250 VA	1. Study of a programmable logic controller. 2. Research of sensors. 3. Study of devices of normalization of signals. 4. Automated experiments of a research of characteristics of sensors.	Automate and mechanise the production processes	
55	Standard set of the educational equipment "Industrial Sensors of Technological Information", execution monoblock manual, PD-TI-MR	Power supply tension - 220 Century. Frequency of power voltage - 50 Hz. Power consumption, no more - 250 BA.	Study of current sensors and tension (6 sensors: the measuring shunt, the current transformer, the integral current sensor on the basis of a Hall effect, a voltage divider, tension transformer, the integral voltage sensor on the basis of a Hall effect): — a study of direct current characteristics of the researched sensors (6 experiments);	Automate and mechanise the production processes	

			<p>— a study of the frequency responses of the researched sensors (6 experiments).</p> <p>2. Study of temperature sensors (6 sensors: thermostat, thermocouple, silicon thermoresistor, platinum thermoresistor, integral temperature sensor, noncontact pyrometer):</p> <p>— a study of direct current characteristics of the researched sensors (6 experiments).</p> <p>3. Study of sensors of a magnetic field (5 sensors: the sealed-contact, the Hall sensor with the discrete output, the analog Hall sensor, a magnet the resistor with the discrete output, a magnet the resistor with an analog output):</p> <p>— operating characteristics of the sealed-contact, a resistor magnet with the discrete output and the Hall sensor with the discrete output (3 experiments);</p> <p>— a study of direct current characteristics of the analog Hall sensor and a magnet of the resistor with an analog output (2 experiments).</p> <p>4. Study of light sensors and color (2 integral sensors):</p> <p>— study of direct current characteristics of the light sensor;</p> <p>— a study of influence of light intensity and type of a light filter on direct current characteristics of the sensor of color (2 experiments)</p>		
55	Standard set of the educational equipment "Industrial Sensors of Technological Information — Pass", execution monoblock manual, PD-TI-MINI-MR	Dimensions of 400x200x250 mm Mass of the stand, no more than 10 kg	Composition: 1. A monoblock "Sensors of technological information" which contains: power supply unit; generator of constant and alternating voltage; current regulator; unit of digital indicators; digital multi meter. 2. A set pass modules (11 pieces): current sensors and tension, temperature sensors, sensors of a magnetic field. 3. Set of cables and bonding wires. 4. Set of accessories for carrying out laboratory operations.	Automate and mechanise the production processes	

			7. A case for storage pass modules. 8. Technical specification on the laboratory bench. 9. Methodical instructions to carrying out laboratory operations.		
57	Standard set of the educational equipment "Installation and Adjustment of Electric Equipment of the Entities and Civil Constructions"	Power supply tension, B 220 Frequency of power voltage, Hz 50 Power consumption, W no more than 80 Operating temperature range? With +10 ... +35 Humidity, % to 80	1. Study of rules of mounting of an electric lighting of the apartment 2. Study of different connection circuits of electric-lighting instruments 3. Study of protection of a lighting network 4. Check of transformers of tension 5. Study of the diagram of switching on of the single-phase active energy meter 6. Checking of the single-phase active energy meter 7. Increase in electrical power factor of an electric equipment by means of condensers 8. Study of operation of the device of protective switch-off (DPSO) 9. Study of contactors of an alternating current 10. Thermal protection of the asynchronous electromotor of an alternating current 11. Study of the diagram of capacitor launch of the three-phase asynchronous electromotor of an alternating current 12. Methods of fault finding and their elimination of the three-phase asynchronous electromotor of an alternating current 13. Study of the diagram of the non-reversing magnetic actuator 14. Study of the diagram of the reverse magnetic actuator	Execute mounting and maintenance of electric installations and automated systems	
58	Standard set of the educational equipment «Installation and Adjustment of Electrical	Capacity 900x600x1460 mm (LxWxD); mass not more than 50 kg.	The list of the demonstrations which are carried out on a set: Part 1. Acceptance tests of electroinstallations 1. Check of a continuity of the conductor 2. Measurement of resistance of isolation of electroinstallation	Apply non-traditional sources of energy in agriculture	





	Installation up to 1000W in systems of electrical power supply", execution bench		3. Measurement of resistance of a floor and walls 4. Measurement of full resistance of a loop "a phase — zero" 5. Measurement of resistance of grounding (two-wire method) 6. Measurement of resistance of grounding (three-wire method) 7. Measurement of specific electric resistance of soil 8. Measurement of reaction time of safety locks, demonstration of thermal protection of AV 9. Demonstration of protective operation of the differential switch (OUZO) 10. Demonstration of operation of the control unit of resistance of isolation 11. Polarity check 12. Measurement of current of leak 13. Check of alternation of phases 14. Measurement of mains voltage and tension of a contact Part 2. Methods of search of malfunctions of electroinstallation 1. Search of violation of a continuity of conductors 2. Search of violation of isolation of conductors 3. Troubleshooting of system of grounding and lightning protection 4. Definition of short circuit in electric equipment chains, violation of conductivity of a loop "phase zero" and alternations of phases		
59	Standard set of educational equipment	Voltage of power supply is 3x380 V Frequency of power voltage is 50 Hz Power consumption, no more than 300 VA	"Bases of relay protection and automatic equipment", execution bench manual, ORZIA-SR List of laboratory works: Section "Relay Protection in Electrical Power Systems": 1. Current cut-off of a power line. 2. The maximum current protection of a power line with independent endurance of time. 3. The maximum current protection of a power line with start-up on tension.	Apply non-traditional sources of energy in agriculture	



			<p>4. Longitudinal differential protection of a power line.</p> <p>5. Differential protection of the transformer.</p> <p>Section "Automation of Electrical Power Systems":</p> <p>1. Automatic repeated inclusion of a power line.</p> <p>2. Automatic repeated turning on of the transformer.</p> <p>3. Automatic inclusion of a reserve of the feeding accession</p>		
60	Standard set of educational equipment	<p>Power supply tension - 220 Century.</p> <p>Frequency of power voltage - 50 Hz. Power consumption, not more than - 500 WA.</p>	<p>"Relay protection", execution bench computer, RZ-SK</p> <p>List of laboratory works:</p> <p>Section "Studying of Element Base and Principles of Operation of the Relay":</p> <p>1. Test of the relay of current.</p> <p>2. Test of the relay of tension.</p> <p>3. Test of a timer.</p> <p>4. Test of the relay of current with limited and dependent endurance of time.</p> <p>5. Test of the relay of the direction of power.</p> <p>6. Test of the differential relay of current.</p> <p>7. Test of the relay of resistance.</p> <p>Section "Studying of Schemes and Principles of Action of Protection":</p> <p>1. Current cut-off of a power line.</p> <p>2. The maximum current protection of a power line with independent endurance of time.</p> <p>3. The maximum current protection of a power line with start-up on tension.</p> <p>4. The maximum current protection of a power line with limited and dependent endurance of time.</p> <p>5. The current directed protection of a power line.</p> <p>6. Differential protection of the transformer.</p> <p>7. Remote protection of a power line.</p> <p>8. Current protection of the transformer (TO, MTZ, protection against an overload).</p>	Apply non-traditional sources of energy in agriculture	


61	Standard set of educational equipment	<p>Voltage of power supply is 3x380 V</p> <p>Frequency of power voltage is 50 Hz</p> <p>Power consumption, no more than 300 VA</p>	<p>"Relay protection, automatic equipment and quality of electric energy of electrical power systems", execution desktop with the laptop, RZAIK-NN</p>  <p>The laboratory bench provides a research of the set and emergency operation of operation of electrical power systems taking into account operation of devices of relay protection and automatic equipment, existence of means of voltage regulation and devices of a reactive power compensation, quality management of electrical energy on distributive networks, existence of electrical loading of different type.</p> <p>Overall dimensions (without notebook) 2140x650x400 mm</p> <p>Weight, no more than 250 kg</p> <p>Technical characteristics:</p> <p>Voltage of power supply is 3x380 V</p> <p>Frequency of power voltage is 50 Hz</p> <p>Power consumption, no more than 300 VA</p> <p>Composition:</p> <ol style="list-style-type: none"> 1. Modules: supply of the bench; three-phase network; power meter; measuring; autotransformer; power lines (3 pieces); switch (4 pieces); longitudinal capacitive compensation; single-phase transformers (2 pieces); the resistive load; capacitive load; single-phase detector loading and the filter of the compensating device; input-output with an I/O card. 2. Notebook. 3. Frame (2 pieces). 4. Set of bonding wires and power cables. 5. Software (compact disk). 	Apply non-traditional sources of energy in agriculture	
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		<p>6. Technical specification on the laboratory bench.</p> <p>7. Methodical instructions to carrying out laboratory operations.</p> <p>List of laboratory operations:</p> <p>Section "Relay Protection in Electrical Power Systems":</p> <ol style="list-style-type: none"> 1. The current cut-off. 2. The maximum current protection with an independent exposure of time. 3. The maximum current protection with start-up on tension. 4. The maximum current protection with a limited and dependent exposure of time. 5. Protection against single-phase short circuits on the earth. 6. Longitudinal differential protection of the power line. 7. Differential protection of the transformer. 8. Differential protection of buses. <p>Section "Automation of Electrical Power Systems":</p> <ol style="list-style-type: none"> 1. Automatic repeated switching on of a power line. 2. Automatic repeated switching on of buses. 3. Automatic switching on of a reserve of the feeding association. 4. Automatic switching on of a reserve of the section switch. <p>Section "Quality of Electrical Energy":</p> <ol style="list-style-type: none"> 1. Measurement of figures of merit of electrical energy. 2. Determination of influence of a voltage deviation on the power consumed by the resistive load. 3. Determination of influence of a voltage deviation on the power consumed by the inductive loading. 4. Determination of influence of a voltage deviation on the power consumed by a capacitive load. 	
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			<p>5. Voltage regulation by a longitudinal capacitive compensation of reactive power.</p> <p>6. Voltage regulation by a cross capacitive compensation of reactive power.</p> <p>7. Lowering of level of generation of the higher harmonics by changeover of the half-wave rectifier on double-wave in a loading feed circuit a direct current.</p> <p>8. Compensating of the higher harmonics of current with the help the filter of the compensating device.</p>		
62	Laboratory stand		<p>Mounting and adjustment of an electric equipment of the enterprises and civil constructions</p> <p>1. Tests of an electric equipment.</p> <p>1.1. Determination of coefficient of return of the electromagnetic contactor.</p> <p>1.2. Determination of an error of the transformer of tension.</p> <p>1.3. Checking of the active energy meter of a single-phase electric current.</p> <p>2. Wiring and adjustment of diagrams of relay and contactor control of three-phase asynchronous engines with a short-circuited rotor.</p> <p>2.1. Wiring and adjustment of the control diagram the three-phase asynchronous engine with support of its direct start-up.</p> <p>2.2. Wiring and adjustment of the control diagram the three-phase asynchronous engine with support of its direct start-up and a reverse.</p> <p>2.3. Setup and test of the diagram of the thermal protection of the three-phase asynchronous engine based on use of the electrothermal relay.</p> <p>2.4. Wiring and adjustment of the control diagram the three-phase asynchronous engine with support of its direct</p>	Apply non-traditional sources of energy in agriculture	


			<p>capacitor start-up in case of a supply from a single-phase network. 2.5. Wiring and adjustment of the control diagram the three-phase asynchronous engine with support of its direct start-up and increase in electrical power factor with switching on of condensers.</p> <p>3. Wiring and adjustment of circuits of electric lighting.</p> <p>3.1. Circuits of switching on of electric-lighting instruments.</p> <p>3.2. Circuits of control of lighting.</p> <p>3.3. Circuit of the active energy meter of a single-phase electric current.</p> <p>3.4. Circuit of protection of a lighting network.</p> <p>3.5. A circuit with the device of protective switch-off.</p> <p>3.6. Circuit of electric lighting of the apartment..</p>		
63	"Solar, Wind and Hydroelectric Power Plants" laboratory	Solar		Apply non-traditional sources of energy in agriculture	
64	Visual aids		Models of geometric bodies for graphical works	Apply non-traditional sources of energy in agriculture	
65	"Thermal Pumps, Biogas and Biodiesel Installations" laboratory	Geo-thermal		Apply non-traditional sources of energy in agriculture	
66	Stand - "The Thermal Pump with Use of Geothermal Low-potential Energy" exercise machine	Geothermal		Apply non-traditional sources of energy in agriculture	
67	Stand - "The Thermal Pump with Use of Geothermal Low-potential Energy" exercise machine	Solar	 <p>1. Research of the solar battery.</p> <p>2. Study of operation of autonomous photo-electric system</p>		

68	Standard set of the educational equipment "Wind Power System on the basis of the Synchronous Generator", execution table with a notebook,	Wind energy	 <ol style="list-style-type: none"> 1. Measurement of speed of moving of the wind generator. 2. Measurement of minimum operating rate of wind. 3. Generator no-load characteristic. 4. External characteristics of the wind generator. 5. A study of operation of autonomous wind power system with the battery and loading.. 	Apply non-traditional sources of energy in agriculture	
69	Laboratory complex "Hydropower — System the Turbine Generator"	Hydro-energy	 <ol style="list-style-type: none"> 1. Studying of a design of the turbine of Pelton. 2. Studying of a design of the radial-axial turbine. 3. Studying of a design of the axial turbine. 4. Studying of a design of the generator. 5. A research of characteristics of system Pelton's turbine – the generator – loading. 6. A research of characteristics of system Pelton's turbine – the generator – loading during the work with one nozzle device 7. A research of characteristics of system the radial-axial turbine – the generator – loading 8. A research of characteristics of system the axial turbine – the generator – loading. 9. Studying of ways of turning on of generators for increase in power at the exit: parallel connection of two generators. 10. Studying of ways of turning on of generators for increase in power at the exit: consecutive connection of two generators". 	Apply non-traditional sources of energy in agriculture	

70	Laboratory complex "Device of Biodiesel Installation"	Geothermal		Apply non-traditional sources of energy in agriculture	
	Visual aids		models of solids for performance of graphic works	Apply software in solution of mathematical tasks in electrical energy sector	
71	Matlab	Компьютерная программа	Application program package for the decision of tasks and technical computation.	Apply software in solution of mathematical tasks in electrical energy sector	
72	Software computer program	Компьютерная программа	The program is a system of circuitry modeling and the analysis of electric circuits.	Apply software in solution of mathematical tasks in electrical energy sector	
73	Electronics Workbench (EWB)	Software program	The mission of the program is a drawing up schemes electric connections, calculation of currents, tension, drawing up balances of power, creation vector (combined or separate) charts of currents and tension.	Apply software in solution of mathematical tasks in electrical energy sector	
74	Circuit.Magic.	Software program	focused on preparation of interactive documents with calculations and visual maintenance, differs in ease of use and application for collective work.	Apply software in solution of mathematical tasks in electrical energy sector	
75	Mathcad	Software program	The packet of applied mathematical programs providing an open surrounding for engineering and scientific computations.	Apply software in solution of mathematical tasks in electrical energy sector	
	Scilab	Software program	Software in mathematics which unites geometry, algebra and the mathematical analysis.	Apply software in solution of mathematical tasks in electrical energy sector	
76	GeoGebra	Software program	ПО по математике, которое объединяет геометрию, алгебру и математический анализ.	Применять программное обеспечение при решении математических задач в электроэнергетике	
77	Standard set of the educational equipment "Installation	Power supply tension, B 220 Frequency of power voltage, Hz 50 Power	1. Study of rules of mounting of an electric lighting of the apartment 2. Study of different connection circuits of electric-lighting instruments	Execute mounting, alignment of devices of the relay protection and automation	

	<p>a n d Adjustment of Electric Equipment of the Entities and Civil Const ructions"</p>	<p>consumption, W no more than 80 O p e r a t i n g t e m p e r a t u r e range? With +10 ... +35 Humidity, % to 80</p>	<p>3. Study of protection of a lighting network 1. Study of the diagram of switching on of the single- phase active energy meter 2. Checking of the single-phase active energy meter 3. Increase in electrical power factor of an electric equipment by means of condensers 4. Study of operation of the device of protective switch-off (DPSO) 5. Study of contactors of an alternating current 6. Thermal protection of the asynchronous electromotor of an alternating current 7. Study of the diagram of capacitor launch of the three-phase asynchronous electromotor of an alternating current 8. Methods of fault finding and their elimination of the three-phase asynchronous electromotor of an alternating current 9. Study of the diagram of the non-reversing magnetic actuator 10. Study of the diagram of the reverse magnetic actuator</p>	<p>of the power supply systems in agriculture</p>	
	<p>S t a n d a r d set of the educational equipment "Installation a n d adjustment of electroin stallations to 1000B in systems of power supply", stand execution</p>	<p>O v e r a l l dimensions of 900x600x1460 mm (ДxШxВ); weight is no more than 50 kg.</p>	<p>The list of the demonstrations which are carried out on a set: Part 1. Acceptance tests of electroinstallations 1. Check of a continuity of the conductor 2. Measurement of resistance of isolation of electroinstallation 3. Measurement of resistance of a floor and walls 4. Measurement of full resistance of a loop "a phase — zero" 5. Measurement of resistance of grounding (two-wire method) 6. Measurement of resistance of grounding (three-wire method) 7. Measurement of specific electric resistance of soil 8. Measurement of reaction time of safety locks, demonstration of thermal protection of AV</p>	<p>Execute mounting, alignment of devices of the relay protection and automation of the power supply systems in agriculture</p>	

			<p>9. Demonstration protective deystviy differential switch (OUZO)</p> <p>10. Demonstration of operation of the control unit of resistance of isolation</p> <p>11. Polarity check</p> <p>12. Measurement of current of leak</p> <p>13. Check of alternation of phases</p> <p>14. Measurement of mains voltage and tension of a contact</p> <p>Part 2. Methods of search of malfunctions of electroinstallation</p> <p>2. Search of violation of a continuity of conductors</p> <p>3. Search of violation of isolation of conductors</p> <p>4. Troubleshooting of system of grounding and lightning protection</p> <p>5. Definition of short circuit in electric equipment chains, violation of conductivity of a loop "phase zero" and alternations of phases</p>		
78	Standard set of the educational equipment	Voltage of power supply is 3x380 V Frequency of power voltage is 50 Hz Power consumption, no more than 300 VA	<p>"Bases of relay protection and automatic equipment", execution bench manual, ORZIA-SR</p> <p>List of laboratory works:</p> <p>Section "Relay Protection in Electrical Power Systems":</p> <p>1. Current cut-off of a power line.</p> <p>2. The maximum current protection of a power line with independent endurance of time.</p> <p>3. The maximum current protection of a power line with start-up on tension.</p> <p>4. Longitudinal differential protection of a power line.</p> <p>5. Differential protection of the transformer.</p> <p>Section "Automation of Electrical Power Systems":</p> <p>1. Automatic repeated inclusion of a power line.</p> <p>2. Automatic repeated turning on of the transformer.</p> <p>3. Automatic inclusion of a reserve of the feeding accession.</p>	Execute mounting, alignment of devices of the relay protection and automation of the power supply systems in agriculture	



79	Standard set of the educational equipment	Power supply voltage - 220 Century. Frequency of power voltage - 50 Hz. Power consumption, no more - 500 BA.	<p>"Relay protection", execution bench computer, RZ-SK</p> <p>List of laboratory works:</p> <p>Section "Studying of Element Base and Principles of Operation of the Relay":</p> <ol style="list-style-type: none"> 1. Test of the relay of current. 2. Test of the relay of tension. 3. Test of a timer. 4. Test of the relay of current with limited and dependent endurance of time. 5. Test of the relay of the direction of power. 6. Test of the differential relay of current. 7. Test of the relay of resistance. <p>Section "Studying of Schemes and Principles of Action of Protection":</p> <ol style="list-style-type: none"> 1. Current cut-off of a power line. 2. The maximum current protection of a power line with independent endurance of time. 3. The maximum current protection of a power line with start-up on tension. 4. The maximum current protection of a power line with limited and dependent endurance of time. 5. The current directed protection of a power line. 6. Differential protection of the transformer. 7. Remote protection of a power line. 8. Current protection of the transformer (TO, MTZ, protection against an overload). 	Execute mounting, alignment of devices of the relay protection and automation of the power supply systems in agriculture	
80	Standard set of the educational equipment	Voltage of power supply is 3x380 V Frequency of power voltage is 50 Hz Power consumption, no more than 300 VA	<p>"Relay protection, automatic equipment and quality of electric energy of electrical power systems", execution desktop with the laptop, RZAIK-NN</p>  <p>The laboratory bench provides a research of the set and emergency operation of operation of electrical power systems taking into account operation of devices of relay</p>	Execute mounting, alignment of devices of the relay protection and automation of the power supply systems in agriculture	

			<p>protection and automatic equipment, existence of means of voltage regulation and devices of a reactive power compensation, quality management of electrical energy on distributive networks, existence of electrical loading of different type.</p> <p>Overall dimensions (without notebook) 2140x650x400 mm</p> <p>Weight, no more than 250 kg</p> <p>Technical characteristics:</p> <p>Voltage of power supply is 3x380 V</p> <p>Frequency of power voltage is 50 Hz</p> <p>Power consumption, no more than 300 VA</p> <p>Composition:</p> <ol style="list-style-type: none"> 1. Modules: supply of the bench; three-phase network; power meter; measuring; autotransformer; power lines (3 pieces); switch (4 pieces); longitudinal capacitive compensation; single-phase transformers (2 pieces); the resistive load; capacitive load; single-phase detector loading and filter compensating device; input-output with an I/O card. 2. Notebook. 3. Frame (2 pieces). 4. Set of bonding wires and power cables. 5. Software (compact disk). 6. Technical specification on the laboratory bench. 7. Methodical instructions to carrying out laboratory operations. <p>List of laboratory operations:</p> <p>Section "Relay Protection in Electrical Power Systems":</p> <ol style="list-style-type: none"> 1. The current cut-off. 2. The maximum current protection with an independent exposure of time. 3. The maximum current protection with start-up on tension. 4. The maximum current protection with a limited and dependent exposure of time. 	
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			<p>5. Protection against single-phase short circuits on the earth.</p> <p>6. Longitudinal differential protection of the power line.</p> <p>7. Differential protection of the transformer.</p> <p>8. Differential protection of buses.</p> <p>Section "Automation of Electrical Power Systems":</p> <p>1. Automatic repeated switching on of a power line.</p> <p>2. Automatic repeated switching on of buses.</p> <p>3. Automatic switching on of a reserve of the feeding association.</p> <p>4. Automatic switching on of a reserve of the section switch.</p> <p>Section "Quality of Electrical Energy":</p> <p>1. Measurement of figures of merit of electrical energy.</p> <p>2. Determination of influence of a voltage deviation on the power consumed by the resistive load.</p> <p>3. Determination of influence of a voltage deviation on the power consumed by the inductive loading.</p> <p>4. Determination of influence of a voltage deviation on the power consumed by a capacitive load.</p> <p>5. Voltage regulation by a longitudinal capacitive compensation of reactive power.</p> <p>6. Voltage regulation by a cross capacitive compensation of reactive power.</p> <p>7. Lowering of level of generation of the higher harmonics by changeover of the half-wave rectifier on double-wave in a loading feed circuit a direct current.</p> <p>8. Compensating of the higher harmonics of current by means of the filtrokompensiruyushchy device.</p>		
81	Laboratory stand		Mounting and adjustment of an electric equipment of the enterprises and civil constructions	Execute mounting, alignment of devices of the relay protection	

			<p>1. Tests of an electric equipment.</p> <p>1.1. Determination of coefficient of return of the electromagnetic contactor.</p> <p>1.2. Determination of an error of the transformer of tension.</p> <p>1.3. Checking of the active energy meter of a single-phase electric current.</p> <p>2. Wiring and adjustment of diagrams of relay and contactor control of three-phase asynchronous engines with a short-circuited rotor.</p> <p>2.1. Wiring and adjustment of the control diagram the three-phase asynchronous engine with support of its direct start-up.</p> <p>2.2. Wiring and adjustment of the control diagram the three-phase asynchronous engine with support of its direct start-up and a reverse.</p> <p>2.3. Setup and test of the diagram of the thermal protection of the three-phase asynchronous engine based on use of the electrothermal relay.</p> <p>2.4. Wiring and adjustment of the control diagram the three-phase asynchronous engine with support of its direct capacitor start-up in case of a supply from a single-phase network.</p> <p>2.5. Wiring and adjustment of the control diagram the three-phase asynchronous engine with support of its direct start-up and increase in electrical power factor with switching on of condensers.</p> <p>3. Wiring and adjustment of circuits of electric lighting.</p> <p>3.1. Circuits of switching on of electric-lighting instruments.</p> <p>3.2. Circuits of control of lighting.</p> <p>3.3. Circuit of the active energy meter of a single-phase electric current.</p> <p>3.4. Circuit of protection of a lighting network.</p> <p>3.5. A circuit with the device of protective switch-off.</p> <p>3.6. Circuit of electric lighting of the apartment.</p>	and automation of the power supply systems in agriculture	
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82	Laboratory bench		<p>Quality of electrical energy in systems of electrical power supply with MPSO NTTs-10.65</p> <ol style="list-style-type: none"> 1. Measurement of figures of merit of electrical energy by means of the personal computer. 2. Determination of influence of a voltage deviation on the power consumed by loading. 3. Counter load voltage control 4. Voltage regulation by a cross reactive power compensation by means of the capacitor battery. 5. Voltage regulation by a longitudinal reactive power compensation by means of the capacitor battery 6. Lowering of level of generation of the higher harmonics of current by changeover of the half-wave rectifier on double-wave in a loading feed circuit a direct current. 7. Compensating of the higher harmonics of current with the help the filter of the compensating device 	Define indices of reliability and quality of electric energy in the power supply systems	
83	Virtual laboratory stand		<p>“Locksmith – electrician”</p>  <p>Dismantling, repair and assembly of nodes and devices of average complexity, electric lighting armature. Connection of details and nodes of electromachines, electrode devices and electric devices according to schemes of average complexity. Tinning, soldering, isolation, laying and merging of electrical wires and cables. Technologies and methods of control over hoisting-and-transport mechanisms, strappings of freights.</p>	Perform mounting and maintenance of electric installations and automated systems	

84	Standard set of educational equipment		<p>"Wiring in inhabited and office rooms", bench execution EZhiOP-</p>  <p>SR Apartment switchboard chains with two-wire electric network and the device of protective shutdown Chains of distribution of a guard of the standard apartment with system of grounding TN-C-S Chains of distribution of a guard of the apartment of the increased comfort Chains of distribution of a guard of office Chains of turning on of glow lamps Chains of inclusion of luminescent lamps Chains management of lighting Group two-wire network with the device of protective shutdown Group electric network of bathing and toilet rooms in the standard apartment with system of grounding TN-C-S Group electric network of a hall and kitchen in the standard apartment with system of grounding TN-C-S Group electric network of lighting and sockets of bathing and toilet rooms in the apartment of the increased comfort with system of grounding TN-C-S Group electric network of a hall and kitchen of the apartment of the increased comfort with system of grounding TN-C-S</p>		
85	Standard set of educational equipment		<p>"Electroassembly table / 380B" Subject 1. Technology of electric installation work (H1-TEMR set)</p> 	Perform mounting and maintenance of electric installations and automated systems	

			<p>1. Electrical wiring. 2. Connection of wires and cables. 3. Electroinstallation devices. Subject 2. Electrical circuits in life and on production (a set of N2-ETsBP/380) 1. Wiring of diagrams of electrical power supply of inhabited, office and production locations in the TN-C, TN-S, TT, IT systems. 2. Group networks of an electric lighting, electrosockets and other electric devices. Subject 3. Operation and adjustment of control diagrams electromotors (sets H6-ENSEDCHP/380, H7-ENSED/380) 1. Wiring of diagrams of launch of asynchronous electromotors. 2. Wiring of diagrams of the non-reversing and reverse magnetic actuator. 3. Wiring of thermal protection of the electromotor. 4. Wiring of the control diagram of the asynchronous electromotor by means of the frequency transformer. Subject 4. Mounting and adjustment of circuits of a disturbing signaling (N10-MNTsTS set) 1. Mounting and adjustment of circuits of the fire warning. 2. Mounting and adjustment of circuits of a security signaling. Subject 5. Mounting and adjustment of electrical circuits of control and automatic equipment. Control diagrams industrial equipment (N11-MNETsA set) 1. Wiring of control diagrams using the intermediate relays. 2. Wiring of control diagrams using the time delay switch. 3. Wiring of control diagrams using the relay of current and the relay of tension. 4. Wiring of control diagrams using controllers and sensors. 5. Wiring of control diagrams using the current transformer and the transformer of tension.</p>		
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			<p>6. Wiring of control diagrams using pneumo-hydrovalves.</p> <p>Subject 6. Energy saving technologies in lighting engineering (set H5-ESTS)</p> <ol style="list-style-type: none"> 1. Wiring of diagrams of lighting using motion sensors. 2. Wiring of diagrams of lighting using the photo relay. 3. Wiring of diagrams of lighting using dimmers. 4. Wiring of diagrams of lighting using timers. <p>Subject 7. Circuits of electrical measuring instruments (set H4-TsEiP)</p> <ol style="list-style-type: none"> 1. Wiring of diagrams using electrical measuring instruments. 2. Wiring of diagrams using the active power meter. 3. Wiring of diagrams using the single-phase active energy meter. 		
86	Virtual laboratory stand		 <p>'Mounting of printing plates VLS –MPP</p>	Perform mounting and maintenance of electric installations and automated systems	
87	Laboratory stand		 <p>Initiator of electric drives defects</p>	Perform mounting and maintenance of electric installations and automated systems	
88	Laboratory		 <p>"Installation, adjustment and repair of electrochains, electric equipments, drives and automatic equipment"</p>	Perform mounting and maintenance of electric installations and automated systems	
			<p>principles and processes: modular program for managers</p> <p>"Management of development of the organization"</p>		
89	General management of Rymantsev's organization of Z.P.IN FRA-M, 2000		<p>principles and processes: modular program for managers</p> <p>"Management of development of the organization"</p>	Manage structural division	

10. The list of recommended literature

№	Name and number of edition	Author	Printing house Year and place of issue	Module (s), where it is used
1	Three - dimension computer modelling in a higher institution // Computer geometry and graphics in education.	Yuri Rogoza	Krasnoyarsk: Publ KSTU 2000	Model electric schemes using the software
2	Engineering graphics: practicum	Mikhailov G.M.	Tambov TSTU 2010	Model electric schemes using the software
3	Engineering graphics	Brodskiy A.M.	Academy M., 2013	Model electric schemes using the software
4	Practicum in engineering graphics	Brodskiy A.M.	Academy M., 2013	Model electric schemes using the software
5	Assembly of exercises for drawings in the engineering graphics	Mironov B.G.	Academy M., 2013	Model electric schemes using the software
6	Electric technics and the basics of electronics 7 -th edition	Ivanov II, Soloviev G.I Frolov V.J.	"Lan" Publisher 2012 (736s).	Analyze electrical systems, electronic technics and control its functions
7	Electrical technics for electrical technical professions 2 ndedition	Proshin V.M.	2016	Analyze electrical systems, electronic technics and control its functions
8	Electrotechnics, electronics, electric equipment	G . A . Farnasov	M .: Publishing House MISA 2012	Analyze electrical systems, electronic technics and control its functions
9	Electrical technics and electronics: electrical technics in equipment Lucas-Nulle. Laboratory practicum	M . V . Kolistratov, L.A. Shaposhnikov, M.A. Ognev	M .: Publishing House MISA 2012	Analyze electrical systems, electronic technics and control its functions
10	Electrotechnics and electronics	Voronin M.J., Gorbachev A.P.	Novosibirsk SSGA 2013	Analyze electrical systems, electronic technics and control its functions
	Electrotechnics with basics of electronics: textbook for students of vocational schools, lyceums and students of colleges	Fedorchenko, A.A. / A.A. Fedorchenko, G. Sindeev	Dashkov i K °, 2010	Analyze electrical systems, electronic technics and control its functions
12	Electrotechnics: teaching aid	Kataenko Y.K. / Y.K .Kataenko. - M .: Dashkov and K	Rostov n / D: Akademtsentr 2010.	Analyze electrical systems, electronic technics and control its functions
13	Electrotechnics and basics of electronics 7 th edition	Ivanov I.I., Soloviev G.I. Frolov V.J.	"Lan" Publisher 2012 (736s).	Analyze electrical systems, electronic technics and control its functions
	Electrotechnics for electrical technical professions 2 ndedition	Proshin V.M.	2016	Analyze electrical systems, electronic technics and control its functions
14	Electrical machines of direct current	Vodelsk A.I. Popov	PETER 2010	Diagnose electric machines and transformers
15	Electrical machines. Teaching and reference aid	Aliyev I.I.	Radio IP Software "2011	Diagnose electric machines and transformers

16	Electrotechnics and electrical machines	E.. Maltsev	"Crown Century", 2010	Diagnose electric machines and transformers
17	Electrical machines. Teaching and reference aid	Aliyev I.I.	Software Radio ", 2011	Diagnose electric machines and transformers
18	Electrotechnics and electric machines	Maltsev E.L.	"Crown Century", 2010	Diagnose electric machines and transformers
19	Modelling of electrical machines in the media MATLAB	Sagitov P.I., Y.I. Shadhin, T o y g o zhinova J.J.	Almaty AUPET, 2014.	Diagnose electric machines and transformers
20	Asynchroic engines with short-circuit rotor. Methodical instructions to the term paper	Shiderova R.M., A.N. Besterekova	Almaty: AUPET 2014	Diagnose electric machines and transformers
21	Electrical machines. Asynchronous engines with phase rotor (calculation of geometrical dimensions and wheevings).Methodical instructions to the term paper	R . M . Shide r o v a , A . N . Beste rekova	Almaty: AUPET 2011	Diagnose electric machines and transformers
22	Electrical machines. Methodical instructions to laboratory works.	Sagitov P.I., Shiderova R.M.,	Almaty AUPET 2013	Diagnose electric machines and transformers
23	Electrical machines. Methodical isntuctions to laboratory works. Part 2.	Sagitov P.I., Shiderova R.M.,	Almaty AUPET, 2013	Diagnose electric machines and transformers
24	Synchronic machines. Methodical isntuctions to laboratory works.	Sagitov P.I., Shiderova R . M . , Almuratova	Almaty AUPET 2012	Diagnose electric machines and transformers
25	Asynchronous engines with short-circuit rotor.	Shiderova R.M, A.N. Besterekova	Almaty: AUPET 2014	Diagnose electric machines and transformers
26	Electrical machines. Asynchronous engines with the phase rotor (calculation fo geometrical dimensions amd wheevings	R . M . Shide rova, A.N.Beste rekova	Almaty: AUPET 2011	Diagnose electric machines and transformers
27	Electrical machines. Methodical instructions to laboratory works.	Sagitov P.I., Shiderova R . M . , Almuratova. Part 1	Almaty AUPET 2013	Diagnose electric machines and transformers
28	Electrical machines.	Bespalov V.Y.	"Academy", 2010.	Diagnose electric machines and transformers
29	About approval of the Energy Saving - 2020 Program. 6. The law of the Republic of Kazakhstan "About energy saving and increase in an energy efficiency"	Resolution of the Government of the Republic of Kazakhstan	on August 29, 2013 № 904 (as amended on 10.07.2012, the)	Maintain agricultural electrical installations and units

30	Methodical benefit on an explanation of basic provisions of the president's letter RK of N.A. Nazarbayev to the people of Kazakhstan "Let's construct the future together"		Astana, 2011	Maintain agricultural electrical installations and units
31	Green planting	Abylkairova B. Esengabulov S. Mendymbayeva C	Astana, 2011	Maintain agricultural electrical installations and units
32	Electric lighting and radiation. Educational and methodical complex.	A.N. Babko	Astana: Kazakh ATU 2011	Maintain agricultural electrical installations and units
33	The electronic start-regulating devices for discharge lamps and system of automatic control of lighting.	Canines M.E. (Edited by prof. J.B. Eisenberg)	Moscow House of Light. 2011	Maintain agricultural electrical installations and units
34	Energy efficient electric lighting	C.M. Nogtev and etc.; ed. A.P. Varfolomeeva.	M.: Publishing House MEI 2013	Maintain agricultural electrical installations and units
35	Power and light audit in buildings, constructions and street lighting	Babko A.N., S.P. Inyutin	Astana LLP "1C-Service", 2014.	Maintain agricultural electrical installations and units
36	Elementary lighting engineering	Varfolomeev L.P.	Moscow 2013	Maintain agricultural electrical installations and units
37	Theory of electric drive	Klyuchev V.I.	M.: Energoatomisdat 2001	Maintain agricultural electrical installations and units
38	Electric drive	S.K. Kozyrev	Idatelstvo MES 2015	Maintain agricultural electrical installations and units
39	Automated control of electric drive part 1	Pankratov V.V.	Novosibirsk Novosibirsk State Technical University, 2013	Maintain agricultural electrical installations and units
40	Automated electric drive	S.N. Pavlovich	Minsk, Belarusian National Technical University 2012	Maintain agricultural electrical installations and units
41	Catalogue of the lamps of the company.		PHILIPS. 372014	Maintain agricultural electrical installations and units
42	Product catalogue		LiderLayt. 2014	Maintain agricultural electrical installations and units
43	Diode lighting		Optimum 2013	Maintain agricultural electrical installations and units

44	Concept of creation of a center of energy efficiency in Kazakhstan.		Astana, 2011.	Maintain agricultural electrical installations and units
45	Electrical units (5th ed., Rev.) Textbook	Devochkin O.V.	"Publishing Center" Academy", Almaty 2015	Maintain agricultural electrical installations and units
46	Electrical drive (7-th ed., Rev.) Textbook	Moskalenko V.V.	Academy", "Publishing Center" Almaty 2014	Maintain agricultural electrical installations and units
47	Electrical machines (15-th ed., Rev.)Textbook	K a t z m a n M.M.	Academy", "Publishing Center" Almaty 2016	Maintain agricultural electrical installations and units
48	Laboratory works in electrical machines and electrical drive (9-th ed., Rev.)Textbook	K a t z m a n M.M.	Academy", "Publishing Center" Almaty 2016	Maintain agricultural electrical installations and units
49	Collection of tasks in electrical machines (7 th ed. Rev.) Teaching aid	K a t z m a n M.M.	Academy", "Publishing Center" Almaty 2016	Maintain agricultural electrical installations and units
50	Electrical drive (7 th ed., Rev.) Textbook	K a t z m a n M.M.	Academy", "Publishing Center" Almaty 2016	Maintain agricultural electrical installations and units
51	Electrical machines (2 nd ed., Rev.) Textbook	Lobzin SA	Academy", "Publishing Center" Almaty 2016	Maintain agricultural electrical installations and units
52	Electrical drive in modern technologies (1 st ed.) Textbook	Novikov VA	Academy", "Publishing Center" Almaty 2014	Maintain agricultural electrical installations and units
53	Electrical drive (3d ed., Rev . And additions) textbook	Onishchenko G.B.	Academy", "Publishing Center" Almaty 2013	Maintain agricultural electrical installations and units
54	Basics of electrical drive: teaching aid. 2 nd ed. * 2016.	Epifanov A.P.	"DOE" Publishing House, St. Petersburg 2016	Maintain agricultural electrical installations and units
55	Electrical mechanic transformers of energy: teaching aid in 2016.	Epifanov A.	"DOE" Publishing House, St. Petersburg 2016	Maintain agricultural electrical installations and units
56	Design of electric drive of industrial mechanisms. Teaching aid, 1 st ed.	F r o l o v Yu., V.P. Shelyakin	"DOE" Publishing House, St. Petersburg 2016	Maintain agricultural electrical installations and units
57	Catalogue of products. Diode lighting		Optimum 2013.	Maintain agricultural electrical installations and units
58	Electrical machines of direct current	Vodetsk A.I. Popov B.	PETER 2010	Diagnose electrical machines and units
59	Electrical machines. Teaching and reference aid	Aliyev I.I.	Radio IP Software "2011	Diagnose electrical machines and units
60	Electrotechnics and electrical machines	E.L. Maltsev	"Crown Century", 2010	Diagnose electrical machines and units
61	Electrical machines. Teaching and reference aid	Aliyev I.I	Software Radio ", 2011	Diagnose electrical machines and units
62	Electrotechnics and electric machines	EL Maltsev	"Crown Century", 2010	Diagnose electrical machines and units

63	Modelling of electric machines in the media MATLAB	Sagitov PI, Shadhin JJ, Toygozhinova	Almaty AUPET, 2014.	Diagnose electrical machines and units
64	Asynchronous engines with sort-circuit rotor. Methodic instructions to the term paper	Shiderova R.M., A.N. Besterekova	Almaty: AUPET, 2014	Diagnose electrical machines and units
65	Electrical machines. Asynchronous engines with phase rotor (calculation of geometrical dimensions and wheevings).Methodical instructions to the term paper	R.M.Shiderova, A.N.Besterekova	Almaty: AUPET, 2011	Diagnose electrical machines and units
66	Electrical machines. Methodical instructions to the laboratory papers.	Sagitov P.I., Shiderova R. M. , Almuratov	Almaty AUPET, 2013	Diagnose electrical machines and units
67	Electrical machines. Methodical instructions to the laboratory papers. Part 2.	Sagitov P.I., Shiderova R. M. , Almuratova	Almaty AUPET, 2013	Diagnose electrical machines and units
68	Synchronic machines. Electrical machines. Methodical instructions to the laboratory papers	Sagitov P.I., Shiderova R. M. , Almuratova	Almaty AUPET, 2012	Diagnose electrical machines and units
69	Asynchronous engines with short-circuit rotor	Shiderova R.M., A.N. Besterekova	Almaty: AUPET, 2014	Diagnose electrical machines and units
70	Electrical machines. Asynchronous engines with phase rotor(calculation of geometrical diensions and wheevings)	R.M.Shiderova, A.N.Besterekova	Almaty: AUPET, 2011	Diagnose electrical machines and units
71	Electrical machines. Methodical instructions to the laboratory papers	Sagitov P.I., Shiderova R. M. , Almuratova. Part 1	Almaty AUPET, 2013	Diagnose electrical machines and units
72	Electrical machines.	Bespalov V.Y.	"Academy", 2010.	Diagnose electrical machines and units
73	"Occupational health in energy systems"	J Amanzholov	Ed. Folio. Astana 2010	Provides and maintains agricultural production ith electric power
74	The organization of work and security guidelines and labor protection in the Republic of Kazakhstan + CD		2013	
75	Labor protection in power supply systems.Manual	Amanzholov JK	Astana: Folio, 2007.	Provides and maintains agricultural production ith electric power
76	Power supply of agriculture.	T.B. Leshchin skaya, I.V. Naumov	Clos: 2008.	Provides and maintains agricultural production ith electric power

77	Networks of power supply. Methods and means of ensuring of quality of energy	C u s c o , AA / A.A. Cusco, M. Thompson, e d . f r o m English.A.N. Rabodzeya -	MM: Dodeka- XXI, 2011.	Provides and maintains agricultural production ith electric power
78	Power supply of industrial enterprises and municipal objects: collection of laboratory works	L . Y . Patrickeyev, O . M . Krastelev.	S e v a s t o p o l : SNUNEI 2012.	Provides and maintains agricultural production ith electric power
79	Power supply of consumers and modes: the education guidance for higher education institutions on eg prep. 140400 "Power industry and electrical equipment"	B.I. Kudrin B.V. Zhilin V. Matyunina	M .: Publishing. House MEI 2013.	Provides and maintains agricultural production ith electric power
80	The collection of test tasks of materials on testing on discipline "Power supply of industrial and municipal facilities"		S e v a s t o p o l : SNUNEI 2008	Provides and maintains agricultural production ith electric power
81	Power supply of agriculture. Practical work.	G . I . Yanukovych I.V. Proto sovitsky A.I. Zelenkevich	INFRA-M , 2014 -	Provides and maintains agricultural production ith electric power
82	About approval of the Energy Saving - 2020 Program. 6. The law of the Republic of Kazakhstan "About energy saving and increase in an energy efficiency"	Resolution of the Government of the Republic of Kazakhstan	on August 29, 2013 № 904 (as amended on 10.07.2012, the)	Maintain electrical equipment and means of automation
83	Methodical benefit on an explanation of basic provisions of the president's letter RK of N A Nazarbayev to the people of Kazakhstan "Let's construct the future together"		Astana, 2011	Maintain electrical equipment and means of automation
84	Green planting.	Abylkairova B. Esenga bulov S. M e n d y bayeva C	Astana, 2011	Maintain electrical equipment and means of automation
85	Electric lighting and radiation. Educational and methodical complex.	A.N. Babko	Astana: Kazakh ATU 2011	Maintain electrical equipment and means of automation
86	The electronic start-regulating devices for discharge lamps and system of automatic control of lighting.	C a n i n e s M.E.(Edited by prof. J.B. Eisenberg)	Moscow House of Light. 2011	Maintain electrical equipment and means of automation

87	Energy efficient electric lighting	C . M . G v o z d e v and etc .; ed. A . P. V a r f o l o m e e v a.	M .: Publishing House MEI 2013	Maintain electrical equipment and means of automation
88	Power and light audit in buildings, constructions and street lighting	Babko A.N., S.P. Inyutin	Astana LLP "1 C - Service", 2014.	Maintain electrical equipment and means of automation
89	Elementary lighting engineering	Vyrfolomeev L.P.	Moscow 2013	Maintain electrical equipment and means of automation
90	Theory of the electric drive	Klyuchev V.I.	M .: Energo atomisdat 2001	Maintain electrical equipment and means of automation
91	electric drive	S.K. Kozyrev	Idatelstvo MES 2015	Maintain electrical equipment and means of automation
92	Automated control of electric drive part 1	P a n k r a t o v V.V.	N o v o s i b i r s k N o v o s i b i r s k State Technical University, 2013	Maintain electrical equipment and means of automation
93	automatic electric	S.N.Pavlovich	Minsk, Belarusian N a t i o n a l T e c h n i c a l University 2012	Maintain electrical equipment and means of automation
94	Catalog firm bulbs.		PHILIPS. 372014	Maintain electrical equipment and means of automation
95	Product Catalog		LiderLayt.2014	Maintain electrical equipment and means of automation
96	LED lightening		Optimum 2013	Maintain electrical equipment and means of automation
97	The concept of creation of the Center for Energy Efficiency in Kazakhstan.		Astana, 2011.	Maintain electrical equipment and means of automation
98	Product Catalog. LED lightening		Optimum 2013.	Maintain electrical equipment and means of automation
99	Electric vehicles (5 th ed., Sr.) Proc. benefit	D e v o c h k i n O.V.	" P u b l i s h i n g Center" Academy ", Almaty 2015	Maintain electrical equipment and means of automation
100	Electric drive (7 th ed., Rev.) Tutorial	Moskalenko V.V.	Academy ", " Publishing Center "Almaty 2014	Maintain electrical equipment and means of automation
101	Electric cars (15 th ed., Sr.) Tutorial	K a t z m a n M.M.	Academy ", " Publishing Center "Almaty 2016	Maintain electrical equipment and means of automation
102	Laboratory work on electric machines and electric (9 th ed., Sr.) Proc. benefit	K a t z m a n M.M.	Academy ", " Publishing Center "Almaty 2016	Maintain electrical equipment and means of automation
103	Problems in electrical machines (7 th ed., Sr.) Proc. benefit	K a t z m a n M.M.	Academy ", " Publishing Center "Almaty 2016	Maintain electrical equipment and means of automation
104	Electric drive (7 th ed., Sr.) Tutorial	K a t z m a n M.M.	Academy ", " Publishing Center "Almaty 2016	Maintain electrical equipment and means of automation

105	Electric machines (2 nd ed., Sr.) Tutorial	Lobzin S.A.	Academy ", Publishing Center "Almaty 2016	Maintain electrical equipment and means of automation
106	Power in modern technologies (1 ed.) Tutorial	Novikov V.A.	Academy ", Publishing Center "Almaty 2014	Maintain electrical equipment and means of automation
107	Electric drive (3rd ed., Rev. And add.) Tutorial	Onishchenko G.B.	Academy ", Publishing Center "Almaty 2013	Maintain electrical equipment and means of automation
108	Fundamentals of electric drive: Uch.posobie. 2nd ed., 2016 *	Epifanov A.P.	Publisher "DOE" St. Petersburg 2016	Maintain electrical equipment and means of automation
109	Electromechanical energy converters: * Uch. posobie 2016	Epifanov A.	Publisher "DOE" St. Petersburg 2016	Maintain electrical equipment and means of automation
110	Design of electric industrial machinery. Training. pos., 1 st ed.	F r o l o v Yu., V.P. Shelyakin	Publisher "DOE" St. Petersburg 2016	Maintain electrical equipment and means of automation
111	M e t r o l o g y , standardization and certification in the energy sector (6 th ed., Rev.) Proc.benefit	Zaitsev S.A.	Academy ", Publishing Center "Almaty 2016	Introduce norms of standardization and metrology in the processes of agricultural production
112	P e r f o r m a n c e measurement and instrumentation (2 nd ed., Corr.) Tutorial	Shishmarev V.Y.	" P u b l i s h i n g Center" Academy ", Almaty 2012	Introduce norms of standardization and metrology in the processes of agricultural production
113	Reliability and quality of measuring instruments (7 th ed., Rev. And ext.)	Rannev G.G.	Academy ", Publishing Center "Almaty 2014	Introducenormsofstandardization and metrology in the processes of agricultural production
114	Information and measuring appliances and electronics / Ed.Ranneva GG (3rd ed., Sr.) Tutorial	Rannev G.G.	Academy ", Publishing Center "Almaty 2009	Introduce norms of standardization and metrology in the processes of agricultural production
115	Basics of Agronomy: a textbook for beginning. prof. form.Ed .N.N. Tretyakova, 4th ed.,	Tretyakova N.N.	MM: IPRO Univ. center "Academy", 2009.	Master the basics of agronomy and cattle breeding
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120	"Occupational safety in power"	J Amanzholov	Ed. Folio. Astana 2010	Maintain and supply agricultural production with electrical power

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123	Power supply of agriculture.	TB Leshchinskaya, IV Naumov	Clos: 2008.	Maintain and supply agricultural production with electrical power
124	Power networks.Methods and tools to ensure the quality of energy	C u s c o , A.A. / A.A. Cusco, M. Thompson, e d . f r o m English.A.N.	M .: Dodeka-XXI, 2011.	Maintain and supply agricultural production with electrical power
125	Power supply of industrial enterprises and public facilities: a collection of laboratory work	L . Y . Patrickeyev, O . M . Krastelev.	S e v a s t o p o l : SNUNEI 2012.	Maintain and supply agricultural production with electrical power
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127	Collection of test tasks in testing materials on the subject "Power supply of industrial and municipal facilities"		S e v a s t o p o l : SNUNEI 2008	Maintain and supply agricultural production with electrical power
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130	Process Automation	I.F. Borodin, Y.Sudnik	Kolos 2004	Automate and mechanise the production processes
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132	The mathematical model of the motion segment weevil in a centrifugal rotary grind the body of feed grain	W.C. Sabiev V.V. Fomin	Advances in science and agribusiness technology. - 2010. - № 2. - S. 62-66	Automate and mechanise the production processes
133	Equipment, mechanization and automation of welding processes: Workshop: A manual for students of secondary vocational education institutions	V.V. Ovchinikov. -	M .: Academy of IC 2012	Automate and mechanise the production processes

134	Fundamentals of automation of production. Laboratory work: A manual for basic vocational education	Panteleev, V.N., V.M. Proshin	M.: Academy of IC 2012	Automate and mechanise the production processes
135	Guidelines for the study of machines for harvesting forage on discipline "Mechanization and electrification and automation of agricultural production", "Agricultural machinery" section	Gorshenin V.I., assistant professor Tara Y. Bukin, Associate Professor SV Solovyov	Michurinsk Science pales 2008	Automate and mechanise the production processes
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147	Installation of electrical and automation equipment: Textbook	Kolomiets A.P. et.al.	2007 KolosS	Execute mounting and maintenance of electrc installations and automated systems
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155	Installation, commissioning, maintenance and repair of electrical equipment of SES, Lectures for the specialty 100400 2006 Irkutsk State Technical University,	A l e k s e e v V.A.	www.twirpx.com / files is /	Execute mounting and maintenance of electrc installations and automated systems
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