**Module Handbook**

**Study program**

**BA Electric Power Engineering**

Оглавление

[1. Healthcare (beginner level) 3](#_Toc392756841)

[2. Healthcare (continuing level) 4](#_Toc392756842)

[3. Basics of mathematics 4](#_Toc392756843)

[4. Basics of profession 4](#_Toc392756844)

[5. State language 4](#_Toc392756845)

[6. Foreign language (level А1-В2) 4](#_Toc392756846)

[7. Сhemical properties of materials 4](#_Toc392756847)

[8. Computer science 4](#_Toc392756848)

[9. State History 4](#_Toc392756849)

[10. Physics 4](#_Toc392756850)

[11. Interaction of human and environment 4](#_Toc392756851)

[12. Electrotechnics 4](#_Toc392756852)

[13. Social and humanitarian knowledge 4](#_Toc392756853)

[14. Technological processes in power engineering 4](#_Toc392756854)

[15. Industrial electronics 4](#_Toc392756855)

[16. Electrical Machines 4](#_Toc392756856)

[17. Materials Study 4](#_Toc392756857)

[18. Electronics and modeling 4](#_Toc392756858)

[19. Automatics 4](#_Toc392756859)

[20. Basics of electrical equipment operation 4](#_Toc392756860)

[21. Basics of Economic Studies 4](#_Toc392756861)

[22. Switching devices in Electric Power Engineering 4](#_Toc392756862)

[23. Design of electrical systems 4](#_Toc392756863)

[24. Metrological provision of electrical equipments 4](#_Toc392756864)

[25. Advanced directions of development of electric power engineering and electrotechnical equipments 4](#_Toc392756865)

[26. Design and operation of power plants and substations 4](#_Toc392756866)

[27. Technical equipment of energy facilities 4](#_Toc392756867)

[28. Electricity supply 4](#_Toc392756868)

[29. Microprocessor electronics 4](#_Toc392756869)

[30. Advanced language training 4](#_Toc392756870)

[31. Production and distribution of electric power 4](#_Toc392756871)

[32. The application of electric power 4](#_Toc392756872)

[33. Provision of alarm conditions control 4](#_Toc392756873)

[34. Economics in Power Engineering 4](#_Toc392756874)

[35. Law culture 4](#_Toc392756875)

[36. Final attestation 4](#_Toc392756876)

# 1. Healthcare (beginner level)

|  |  |
| --- | --- |
| Term of study: | 1, 2 |
| Person responsible for the module | Federov V.N. |
| Lecturer: | Federov V.N. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  1st semester: hours per week - 8;  per semester - 120.  2nd semester: hours per week - 4;  per semester - 60. |
| Workload: | Full-time:  Classroom load: 120 hours  Extracurricular workload: 60 hours  Total: 180 hours |
| Credit points: | 6 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Physical education at school |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate skills of physical training to ensure the full social and professional activity |
| Contents: | 1st semester: athletics (sprint, jumps, throwing) and basketball (technique of kicking, passing and throwing of ball)(the beginner level).  2nd semester: swimming (crawl on breast) and volleyball (technique of passing and serving of ball)( the beginner level). |
| The results of training / exams / exams forms: | Qualifying standards of president tests |
| Technical / multimedia tools: | Sports hall, swimming pool, open ground, playing court |
| References: | 1. Karpenko Е., Korotnova Т, etc. Swimming. Gaming technique of teaching. Publishers.: Теrra-Sport.2009 - 48 pp. 2. Rodin А. V., Guba D.V. Sport games. Techniques and methods of teaching . Publishers.: Academiya. 2012 – 526 pp. 3. Rodin А. V., Guba D.V. Basketball at university: theoretical and methodological support of educational system of training students in sportclub. Teaching aid. Publishers: Sovetskiy sport, 2009 – 168 pp. 4. Polishuk V.D. Using special and bringing exercises in training athletes,Kiev «Olympic literature». 2009 -144 pp. |

# 2. Healthcare (continuing level)

|  |  |
| --- | --- |
| Term of study: | 3, 4 |
| Person responsible for the module | Federov V.N. |
| Lecturer: | Federov V.N. |
| Language: | Russian |
| Curriculum relation: | BaElectric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  3rd semester: hours per week - 8;  per semester - 120.  4th semester: hours per week - 4;  per semester - 60. |
| Workload: | Full-time:  Classroom load: 120 hours  Extracurricular workload: 60 hours  Total: 180 hours |
| Credit points: | 6 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Healthcare (beginner level) |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate skills of physical training to ensure the full social and professional activity |
| Contents: | 3rd semester: athletics (running, throwing, fartlek) and basketball (tactics of attack and defence) (intermediate level).  4th semester: swimming (crawl on back) and volleyball (movement, game on attack and defence) (intermediate level). |
| The results of training / exams / exams forms: | Qualifying standards of president tests |
| Technical / multimedia tools: | Sports hall, swimming pool, open ground, playing court |
| References: | 1. Rodin А. V. , Guba D.V. Sport games. Techniques and methods of teaching . Publishers.: Academiya. 2012 – 526 pp. 2. Rodin А. V. , Guba D.V. Basketball at university: theoretical and methodological support of educational system of training students in sportclub. Teaching aid. Publishers: Sovetskiy sport, 2009 – 168 pp. 3. Polishuk V.D. Using special and bringing exercises in training athletes,Kiev «Olympic literature». 2009 -144 pp. 4. Laflin Т. Like a fish in water. Effective swimming techniques, available for everyone. Publishers: Маnn, Ivanov and Ferber. 2012 - 232 pp. |

# 3. Basics of mathematics

|  |  |
| --- | --- |
| Term of study: | 1, 2 |
| Person responsible for the module | Shmigirilova I.B. |
| Lecturer: | Mathematics 1,2 – Shmigirilova I.B., Klishina Е.А. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  1st semester: hours per week – 10;  per semester – 150.  2nd semester: hours per week – 8;  per semester – 120. |
| Workload: | Full-time:  Classroom load: 90 hours  Extracurricular workload: 180 hours  Total: 270 hours |
| Credit points: | 9 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module. |
| Recommended conditions: | Successfully learning the module is based on the knowledge gained by students in secondary schools of the courses "Algebra and start the analysis", "Geometry" |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge in natural sciences and mathematics. |
| Contents: | Elements of linear algebra and analytic geometry. Introduction into the mathematical analysis. Differential calculus of function of one variable and its applications. Integral calculus of functions of one variable and its applications. Differential calculus of function of several variables. Multiple integrals and their applications. Theory of ranks. Differential equations. Elements of probability theory and mathematical statistics. |
| The results of training / exams / exams forms: | Calculated and graphic works, examination in test form |
| Technical / multimedia tools: | Control and measurement equipment, instruments of specialized laboratory classrooms, computer class with software, modern multimedia complexes |
| References: | 1. Analytic geometry and linear algebra.  Umnov А.Е. М.: МFTI, 2011. 2. [Higher mathematics. Baldin K.V., Bashlikov V.N.](http://www.alleng.ru/d/math/math152.htm)М.:Vishaya shkola, 2010. 3. [Higher mathematics. Guide to solving tasks. Lungu K.N., Makarov E.V.](http://www.alleng.ru/d/math/math152.htm) М.: Fizmatlit, 2010. 4. [Differential equations of mathematical physics in electric engineering. Apollonskiy S.М.](http://www.alleng.ru/d/math/math152.htm) 2012. 5. Tasks on higher mathematics, probability theoty, mathematical statistics, mathematical programming with decisions. Shapkin А.S, Shapkin V.А. М.:Dashkov and K, 2010. 6. Lectures on higher mathematics: a complete course[.  Pismenniy D.T.](http://www.alleng.ru/d/math/math152.htm)М.: 2009. 7. [Mathematics. Bashmakov M.I..](http://www.alleng.ru/d/math/math152.htm)М.: 2012. |

# 4. Basics of profession

|  |  |
| --- | --- |
| Term of study: | 1, 2 |
| Person responsible for the module | Koshekov K.T. |
| Lecturer: | Basics of Power engineering – Koshekov K.T.  Introduction to Speciality – Koshekov K.T.  Study practice – Smirnova O.P. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  1st semester: hours per week – 6;  per semester – 90.  2nd semester:  study practice – 30. |
| Workload: | Full-time:  Classroom load: 30 hours  Extracurricular workload: 60 hours  Study practice – 30 hours  Total: 120 hours |
| Credit points: | 4 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module. |
| Recommended conditions: |  |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge in natural sciences and mathematics |
| Contents: | Sphere, objects, subject and types of professional activity of Bachelor on specialty 5B071600 – “Electric Power Engineering”.  Electric Power Engineering – leading component of energy.  Bachelors’ specialization of specialty 5BV071800 - " Electric Power Engineering " in the North Kazakhstan State University named after M.Kozybayev.  Promising directions in the field of electricity.  Equipment, production technology main workshops of enterprises and their technical and economic indicators.  Company’s structure, internal regulations.  Study of manufacturing processes.  Study Electrical Code of the RK.  Analysis of the grounding system in the enterprise.  Conclusions and suggestions for practice. |
| The results of training / exams / exams forms: | Calculated and graphic works, examination in test form, defense of report on practice. |
| Technical / multimedia tools: | Control and measurement equipment, instruments of specialized laboratory classrooms, computer class with software, modern multimedia complexes. |
| References: | 1. Dukenbaev K.D.Energetics of Kazakhstan. Movement to the market. - Almaty.; Gylym, 1999. 2. Evdokunin G.A. Electric systems and networks. Teaching aid for Electric Power engineering specialries. – SP,; Sizoa m.P. 2001. 3. Bass E.I., Doroguntsev V.G. Relay protection of electric power systems. Edited by A.F.Dyakova. - М.,MEI, 2002. 4. Sibikin Yu.D., Sibikin M.Yu. Electrical safety in the operation of electrical industry. – М.: Academiya, 2004. 5. Rules for Electrical of RK – Almaty, 2012. 6. Guidelines for study practice |

# 5. State language

|  |  |
| --- | --- |
| Module Title: |  |
| Term of study: | 1,2 |
| Person responsible for the module | Beysenbaeva A.S. |
| Lecturer: | Kazakh language - Beysenbaeva A.S. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  1st semester: hours per week – 10;  per semester – 150.  2nd semester: hours per week – 8;  per semester – 120. |
| Workload: | Full-time:  Classroom load: 90 hours  Extracurricular workload: 180 hours  Total: 270 hours |
| Credit points: | 9 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Minimally adequate level of Kazakh and English languages in accordance with SCSE of the RK 6.08.085 - 2010 |
| The objectives of the module/ Expected learning outcomes: | Student must:  have basic skills to analyze the relationship of culture, morality and religion;  demonstrate communication skills;  be able to express orally or in written form own ideas and variants of solving problems in several languages​​ |
| Contents: | The course’s content is focused on formation skills:  - basic skills to analyze the relationship of culture, morality and religion through studying themes of “Country-specific studies”;  - communication skills through studying “Man and society”;  - expressing linguistic knowledge in written or oral forms through writing essay, stories and studying dialogue and monologue speech. |
| The results of training / exams / exams forms: | Computer test and oral examination |
| Technical / multimedia tools: | Multimedia language laboratory, interactive board,multimedia complex. |
| References: | 1. Kazak tilin karapayim dengeyde mengerudin takiriptik leksikalik minimumi, Astana: Ulttik testileu ortalygy, 2011.-30 pp. 2. Kazak tilin bazalyk dengeyde mengerudin takiriptik leksikalik minimumi, Astana, 2011.-54 pp. 3. Kazak tilin orta dengeyde mengerudin takiriptik leksikalik minimumi, Astana, 2011.-66 pp. 4. Kazak tilin ortadan jogary dengeyde mengerudin takiriptik leksikalik minimumi, Astana, 2011.-108 pp. 5. Kazak tilin zhogary dengeyde mengerudin takiriptik leksikalik minimumi, Astana, 2011. -156 p 6. K.Atygaeva. Kazak tili. Negzigi zhane kasibi dengeyde okityn studentterge arnalgan OAK. Petropavl, 2011. 7. Sautova Т.А. Kazak tili. Bastauish zhane zhalgastirushi dengey. Petropavl: Severniy Kazakhstan,2011. |

# 6. Foreign language (level А1-В2)

|  |  |
| --- | --- |
| Term of study: | 1,2 |
| Person responsible for the module | Olkova I.A. |
| Lecturer: | Olkova I.A. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  1st semester: hours per week – 10;  per semester – 150.  2nd semester: hours per week – 8;  per semester – 120. |
| Workload: | Full-time:  Classroom load: 90 hours  Extracurricular workload: 180 hours  Total: 270 hours |
| Credit points: | 9 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Minimally adequate level of Kazakh and English languages in accordance with SCSE of the RK 6.08.085 - 2010 |
| The objectives of the module/ Expected learning outcomes: | Student must:  have basic skills to analyze the relationship of culture, morality and religion;  demonstrate communication skills;  be able to express orally or in written form own ideas and variants of solving problems in several languages |
| Contents: | * Lexical material: * Social-cultural sphere of communication: Clobalization: pros and cons; its influence on the society and a person. Problems of contemporary youth: morality and religion, physiological and relationship issues; * Study-professional sphere of communication: My University; possibilities of education: academic mobility. Jobs and Professions; perspectives of my career - an electric engineer; professional competence; advantages and disadvantages of different professions; leadership traits; decision making; writing essay. * Social-cultural sphere of communication: Health and Healthy Life Style, Law, Human Rights, Environment and environmental problems, Mass Media   Grammar material:  - Tenses (Present, Past, Future – Simple, Continuous, Perfect);  - The passive Voice;  - Modal verbs (might, could, might, can);  - Degrees of comparison (adjectives and adverbs) |
| The results of training / exams / exams forms: | Computer test and oral examination |
| Technical / multimedia tools: | Multimedia language laboratory, interactive board, multimedia complex. |
| References: | 1. Philip Kerry, Ceri Jones. Straight Forward Elementary student’s book, Macmillian Publishers Limited, 2010  2. Philip Kerry, Ceri Jones. Straight Forward Intermediate student’s book, Macmillian Publishers Limited, 2010  3. Philip Kerry, Ceri Jones. Straight Forward Upperintermediate student’s book, Macmillian Publishers Limited, 2010  4. Samoylova E.V., Novoselova O.V. Collection of texts for Engineering specialties in English: teaching-methodological aid.- Petropavlovsk: NKSU named afterM.Kozybayev, 2009.  5. Novoselova О.V. English for the Development of Professional Communicative Skills for Engineering specialties: teaching-methodological aid.- Petropavlovsk: NKSU named afterM.Kozybayev,2013. |

# 7. Сhemical properties of materials

|  |  |
| --- | --- |
| Term of study: | 1 |
| Person responsible for the module | Dyuryagina A.N. |
| Lecturer: | Chemistry – Dyuryagina A.N.,  Materials production – Shatkovskaya N.V. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  1st semester: hours per week – 6;  per semester – 90. |
| Workload: | Full-time:  Classroom load: 30 hours  Extracurricular workload: 60 hours  Total: 90 hours |
| Credit points: | 3 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module. |
| Recommended conditions: | This module is based on knowledge of students, acquainted at secondary school while studying “Chemictry”. |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge in natural sciences and mathematics |
| Contents: | Theoretical fundamentals of chemistry. Structure of Matter.  General patterns of chemical processes. Chemical Thermodynamics. Polymeric materials and their applications in engineering. Electrochemical processes in the energy sector. |
| The results of training / exams / exams forms: | Test and oral examination |
| Technical / multimedia tools: | Multimedia complex, computer class, specialized laboratories |
| References: | 1. Korovin N.V. General chemistry. – High school, 2011 2. Glinka N.L. General chemistry – М.: Knorus, 2012. 3. Hauscroft K., Constail E. A modern course of general chemistry, t. 1-2. – М: Mir, 2013. 4. Pavlov N.N. General and inorganic chemistry. – М.: Drofa, 2012. 5. Prigozhin I., Defey E. Chemical thermodynamics – М.: Binom, 2013 6. Bolatbaev K.N., Dyuryagina A.N. workshop on chemistry. Teaching-methodological aid for HEIs – Petropavlovsk, NKSU named after M.Kozybayev, 2009. |

# 8. Computer science

|  |  |
| --- | --- |
| Term of study: | 1 |
| Person responsible for the module | Klishina Y. A. |
| Lecturer: | Klishina Y. A. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  1st semester: hours per week – 10;  per semester – 150. |
| Workload: | Full-time:  Classroom load: 50 hours  Extracurricular workload: 100 hours  Total: 150 hours |
| Credit points: | 5 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module. |
| Recommended conditions: | This module is based on knowledge of students, acquainted at secondary school while studying “Computer science” |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge in natural sciences and mathematics;  demonstrate skills in the use of software for computing, simulation and implementation of industrial technologies;  be competent in the use of analog and digital, electrical and electronic technologies. |
| Contents: | Computer science as the unity of science and technologies. The structure of a modern computer science. Information, its types and features. Data carrier. Operations with data. Boolean mathematics. Columns and tree graphs. Logic elements of computer. Machine’s organization: principles of von Neumann, the control device, command systems and command types. Input/output and interrupts. Computer’s memory system. Input-output devices. Solving strategies and finding solutions. The concept and properties of algorithms, implementation of algorithms. Flowcharts as the graphical implementation of algorithms. Finite state machines. Turing machine and Post machine. Basic programming constructs. Overview of modern applied software. Information processing means. Tabular processors. Publishing systems. Database management system. Seraphic editors. Multimedia applications. Basic concepts of operating systems. Networks and telecommunications. Technologies of Web-based applications development. Information security and its components. Antivirus programs. Information-communication technologies. Infrastructure of “Electronic Government. Technologies for design and analysis of business processes. Principles for development of technical specifications. Basics of “E-Learning”. “E-Learning” methods. Main components of “E-Learning”. Knowledge assessment methodology. Modern technologies of distance learning courses creation in “E-Learning” medium. |
| The results of training / exams / exams forms: | Examination in test form. |
| Technical / multimedia tools: | Control and measurement equipment, instruments of specialized laboratory classrooms, computer class with software advanced multimedia complexes. |
| References: | 1. Computer science. Groshev A.C., А.: 2010. 2. Computer science. Zryumova А.G., Zryumov Е.А., Pronin S.P., Barnaul: Аlt STU; 2011. 3. Computer science.  Makarova N.V., Volkov V.B.: 2011. 4. Computer science. Taganov L.S., Pimonov A.G., Kemerovo: KuzbSTU; 2010. 5. Computer science.  Khubaeva G.N. Rosteov n/D: MarТ; Fenix, 2010. 6. Computer science: laboratory session. Groshev А.С., А.: 2012. 7. Basics of modern computer science. Kudinov Yu.I., Pashenko F.F., М.: 2011. 8. Modern computer science. Averyanov G.P., Dmitrieva V.V. NIYU MIFI. 2011. |

# 9. State History

|  |  |
| --- | --- |
| Term of study: | 2 |
| Person responsible for the module | Zakharov S.V. |
| Lecturer: | History of Kazakhstan – Zakharov S.V. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  2nd semester: hours per week – 8;  per semester – 120. |
| Workload: | Full-time:  Curricular load: 40 hours  Extracurricular load: 80 hours  Total: 120 hours |
| Credit points: | 4 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module. |
| Recommended conditions: | Background knowledge of school courses on World history, History of Kazakhstan, social science |
| The objectives of the module/ Expected learning outcomes: | Student must:  have basic skills to analyze the relationship of culture, morality and religion;  demonstrate knowledge of the legal, moral and ethical standards in professional activity. |
| Contents: | Formation and development of human society at Kazakhstan territory; evaluation of the economic life of population at different stages of history and its influence on changes in material and spiritual culture, in religious sphere of tribes and people; economic and cultural complex of hunter gatherer and fishers communities at the Stone Age; economic and cultural types of nomads; formation and history of cultures of Scythian-Saks, Sarmat, Old Turkic, Mongoltribes and Kazakh people; ethnogenetic processes; political history of ancient and medieval states; Kazakh people struggle with conquerors; activities of prominent historical personages and national heroes; entry into the Russian Empire; national-liberation movements of the late 18-19 centuries; transformation of Kazakh society in 19-20 centuries; changing of economy, lifestyle, social structure, mentality, becoming a modern structure lifestyle of Kazakh society, formation of multi-ethnic and polycultural society in the country and formation of international and tolerant properties of Kazakh society; Stalin’s modernization and postwar industrialization of Kazakhstan; socio-economic achievements of Kazakhstan in 1960-1980 years; Kazakhstan gained state independence and construction of a sovereign state; internal and external policies of the government at the modern stage; problems and achievements of independent Kazakhstan. |
| The results of training / exams / exams forms: | State examination in computer test form |
| Technical / multimedia tools: | PowerPoint-presentations, electronic texts and maps, multimedia complex |
| References: | 1. History of Kazakhstan. In 5 tomes. Т.4. - Almaty: Atamura, 2009. 2. History of Kazakhstan. In 5 tomes. Т. 5. - Almaty: Atamura, 2010. 3. History of Kazakhstan: Lection course. Edited by K.C.Karazhan. - Almaty: Nur-press, 2009. 4. Kan G.V. History of Kazakhstan. Book for HEIs. – Almaty: Almaty kitap baspasy, 2011. 5. Maydanali Z. Ancient History of Kazakhstan (Turlic period). – Almaty: Raritet, 2010. 6. Sheretov S.G. Up-to date History of Kazakhstan (1985-2002 гг.). – А., 2009. |

# 10. Physics

|  |  |
| --- | --- |
| Term of study: | 2 |
| Person responsible for the module | Repnev A.V. |
| Lecturer: | Repnev A.V., Sartin S.A. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  2nd semester: hours per week – 10;  per semester – 150. |
| Workload: | Full-time:  Classroom load: 50 hours  Extracurricular workload: 100 hours  Total: 150 hours |
| Credit points: | 5 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module. |
| Recommended conditions: | This module is based on knowledge of students, acquainted at secondary school while studying “Physics”. |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge in natural sciences and mathematics;  demonstrate knowledge of laws and models of mechanics, electricity and magnetism |
| Contents: | Physical fundamentals of mechanics. Kinematics. Dynamics of material point and rigid body. Energy as the universal measure of various forms of movement and interactions. Conservation laws. Elements of special relativity in mechanics. Non-inertial reference systems. Statistical physics and thermodynamics. Basics of molecular-kinetic theory. Gas laws. Statistical distributions. Capacity and fluctuations. Molecular-kinetic specific heat theory of ideal gases and its limitations. Basics of thermodynamics. Isoprocesses. Transport phenomena. Electrostatics and DC. Electrostatic field in vacuum. Work of electrostatic field. Conductors in electrostatic field. Dielectrics in electrostatic field. Energy of electric charges interaction. Direct electric current. Electromagnetism. The magnetic field in vacuum. The magnetic field in material. The phenomenon of electromagnetic induction. Maxwell’s equations. Optics.concept on radiation (geometric) optics. The wave equation for electromagnetic field. Properties of light waves. Diffraction of waves. Electromagnetic waves in material. Quantum physics. Thermal radiation. Experimental study of the basic ideas of quantum theory. Wave-particle duality. Temporary and stationary equation of Schrodinger. Hydrogen atoms and molecules in quantum theory. Elements of quantum electronics. Elements of quantum statistics. Condensed state. Electrical conductivity of metals. Atomic nucleus and elementary particles. |
| The results of training / exams / exams forms: | Calculated and graphic works, examination in test form |
| Technical / multimedia tools: | Control and measurement equipment, instruments of specialized laboratory classrooms, computer class with software, advanced multimedia complexes. |
| References: | 1. Trofimova T.I. Course of physics / 20thedition. М. : Publishers centre “Academia”, 2014. 2. Savelev I.V. Course of general physics. 5 tomes.: Lan, 2011. 3. Trofimova T.I. Collection of tasks on the course of physics / 1st edition. М.: Abris, 2013. 4. Trofimova T.I. Basics of physics.. Electrodynamics. М.: KnoRus, 2011 5. Leontev P.I., Dyachenko L.A. Collection of tests on “Physics 1”, Petropavlovsk: NKSU, 2010. 6. Dyachenko L.A. Laboratory session for engineering specialties. Petropavlovsk: NKSU, 2009. 7. Detlaf А.А., Yavoeskit B.M. Course of physics. – М.: High school, 2014. 8. Irodov I.E.Tasks on general physics. – SPb.: Lan, 2009. |

# 11. Interaction of human and environment

|  |  |
| --- | --- |
| Module Title: |  |
| Term of study: | 2 |
| Person responsible for the module | Pashkov S.V. |
| Lecturer: | Ecology and Sustainable Development - Pashkov S.V.,  Basics of Life Safety – Zveryachenko T.S. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  2nd semester: hours per week – 12;  per semester – 180. |
| Workload: | Full-time:  Curricular load: 60 hours  Extracurricular load: 120 hours  Total: 180 hours |
| Credit points: | 6 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module. |
| Recommended conditions: | Background knowledge of school courses on Geography, Biology, Chemistry |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge in natural sciences and mathematics;  have basic skills to analyze the relationship of culture, morality and religion |
| Contents: | Types of anthropogenic impacts on biosphere; air pollution; water pollution; depletion of groundwater ad surface water; soil erosion; desertification; human impacts on the flora and fauna; sustainable development of biosphere.  Risks arising from the interaction between man and techno sphere; legislation in emergency; activities and procedures for emergencies. Collective and individual protection means. Basics of the first aid. |
| The results of training / exams / exams forms: | Examination in computer test form |
| Technical / multimedia tools: | PowerPoint- presentations, electronic texts and maps, multimedia complex |
| References: | 1. Strelnikov V.V. Environmental load rationing. – Krasnodar: Publishers house - Yug, 2012. - 472 pp. 2. Environmental protection. Edited by Ya.D.Vishnyakov. – Moscow: Publishers centre “Academiya”, 2013. 3. Nilokaylina N.E., Melekhova О.P. Ecology. Higher education. 2009. 4. Ecology and environmental protection. V.I.Korobkin., L.V.Peredelskiy. – М.:KnoRus, 2013 . – 329pp. 5. V.I.Korobkin. Ecology: V.I.Korobkin., L.V.Peredelskiy. -14th edition. – Rostov N/D : Fenix, 2008. - 603 pp. 6. Stadnitskiy G.V., Rodionov A.I. Ecology. Teachingaid for HEIs. Highereducation. 2010. 7. Gorelov, А.А. Ecology. - М.: Academiya. 2010. - 399 pp. 8. Denisov V.V., Kurbatova A.S., Denisova I.A. Ecology of the city.- М.: IKC “Mart”, 2008.- 832 pp. 9. Ecology. V.I.Korobkin. – 19th edition. 2014. - 601 pp. 10. Ecology in questions and answers.V.I.Korobkin. 5th edition. 2010. - 378 pp. 11. Ecology and Life Safety. Е.I. Pochekaeva. Higher education. 2010. - 556 pp. 12. Pavlov A.N. Ecology: harmonious exploitation and Life Safety. Higher education. 2010. 13. Sapronov Yu.G. Life Safety. – 5th edition. - М.: Academiya, 2009. - 319 pp. 14. Life Safety. Е.А.Krame-Ageev.-М., 2011.-172 pp. 15. A.V.Frolov, T.N.Bakaeva. Life Safety. Labor protection: Publishers: Fenix. – 2010 16. Life Safety: Smirnov A.T. Publishers: Dropha: 2009. - 375 pp. |

# 12. Electrotechnics

|  |  |
| --- | --- |
| Term of study: | 3, 4 |
| Person responsible for the module | Zykova N.V. |
| Lecturer: | Theoretical Foundations of Electrotechnics 1, 2 – Zykova N.V. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  3rd semester: hours per week – 10;  per semester – 150.  4th semester: hours per week – 8;  per semester – 120. |
| Workload: | Full-time:  Curricular load: 90 hours  Extracurricular load: 180 hours  Total: 270 hours |
| Credit points: | 9 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module. |
| Recommended conditions: | Basics of mathematics, Physics, Computer science |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge in natural sciences and mathematics;  demonstrate knowledge of laws and models of mechanics, electricity and magnetism;  demonstrate knowledge of basics of design, work principles and operation of power engineering objects |
| Contents: | Linear electric circuits of a direct current; Electric chains of single-phase sinusoidal current;  Inductively connected elements;  Three-phase chains;  Not sinusoidal currents;  Transients in linear electric chains; Two-port networks and electric filters;  Chains with the distributed parameters;  Nonlinear electric chains;  Theory of an electromagnetic field. |
| The results of training / exams / exams forms: | Test and oral examination. |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory benches |
| References: | 1. Kasatkin V.S., Nemcov M.B. Theoretical bases of Electrotechnics. М.: Energoatomizdat, 2005. 2. Basharin S.A., Federov V.V. Theoretical bases of Electrotechnics. М.: Academiya, 2004. 3. Bessonov L.A. Theoretical bases of Electrotechnics. - М.: Gardariki, 2006. 4. Novgorodcev А.B. Theoretical bases of Electrotechnics: 30 lectures on theory of electric circuits. –Piter, 2006. |

# 13. Social and humanitarian knowledge

|  |  |
| --- | --- |
| Term of study: | 3, 4 |
| Person responsible for the module | Gongalo V.M. |
| Lecturer: | Philosophy - Gongalo V.M,  Political Science – Kaziev S.Sh.,  Social science - Ippolitova Т.V. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  3rd semester: hours per week – 14;  per semester – 210.  4th semester: hours per week – 6;  per semester – 90. |
| Workload: | Full-time:  Classroom load: 100 hours  Extracurricular workload: 200 hours  Total: 300 hours |
| Credit points: | 10 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | This module is based on knowledge of students, acquainted at secondary school while studying History, Law |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge of the legal, moral and ethical standards in professional activity;  demonstrate communication skills;  have basic skills to analyze the relationship of culture, morality and religion; |
| Contents: | Building awareness of a new type of rationality - as a consequence of private and experimental sciences.  Philosophical comprehension of various forms of scientism - mechanistic, cybernetic, synergistic.  Identification of close interaction with the scientism of philosophical and anthropological issues, and to clarify the true nature of science, religion, philosophy and art.  Society as a sociocultural and sociodynamic system; systemic and structural and functional approaches to the analysis of society; basic laws and laws of social development.  - Individual and society, factors of personality. Social institutions and processes.    - Methods and techniques of sociological research. Analysis of the information collected. The report and recommendations of the survey.  Objects, subjects and method of political science; function of political science; political life and power relations; the role and place of politics in modern societies; civil society, its origins and characteristics; institutional aspects of policy; the political system; political parties, political conflicts and their solutions; political elites; foreign policy of the Republic of Kazakhstan. |
| The results of training / exams / exams forms: | Test and oral examination |
| Technical / multimedia tools: | Multimedia complex |
| References: | 1. Babosov Е.М. Sociology: Thesaurus. – М.: Book house «Librokom», 2009. – 480 pp.  2. Gorshkov М.К. Applied sociology: methodology and methods. – М.: Alfa\_М:INFRA-М, 2009. – 416 pp.  3. Tavokin E.P. Basics of social research methods. М.: INFRA, 2009. – 239 pp.  4. Denisov S.F. History and philosophy of science. – Part 2: science – religion – philosophy – art. – Omsk: «Amfora», 2010. – 278 pp.  5. Lebedev S.А., Rubochkin V.A.А. History of science. Philosopht-methodological analysis. – М.: MPSI, MODEK, 2011. – 352 pp.  6. Antiseri D., Reale J. Western philosophy from sources to our days. From romanticism to our days. – Pnevma, 2010. – 880 pp.  7. Gadzhiev K.S. Politology: basic course. 2nd edition. – М.: YuRAIT, 2011, 2012.  8. Politology. Edited by V.A.Achkasova, V.А. Gutorova. - 2nd edition. – М.: YuRAIT, 2011, 2012.  9. Lavrienko V.N. Politology. – 3rd edition. - М.: YuNITI, 2009, 2010.  10. Demidov А.I. Politology. - М.: Gardarika, 2009. – 320 pp. |

# 14. Technological processes in power engineering

|  |  |
| --- | --- |
| Term of study: | 3, 4 |
| Person responsible for the module | Shatkovskaya N.V. |
| Lecturer: | Fundamentals of heat supply – Shatkovskaya N.V.,  Standard acts of Power Engineering – Shatkovskaya N.V.,  Production practice – Latypov S.I. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  3rd semester: hours per week – 4;  per semester – 60.  4th semester: Production practice – 120. |
| Workload: | Full-time:  Curricular load: 20 hours  Extracurricular load: 40 hours  Production practice: 120 hours  Total: 180 hours |
| Credit points: | 6 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Basics of mathematics, Physics, Сhemical properties of materials |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge of basics of design, work principles and operation of power engineering objects |
| Contents: | Technical Thermodynamics. The laws of thermodynamics. Thermodynamic processes. Fundamentals of the theory of heat transfer. Thermal conductivity. Convective heat transfer. Thermal radiation. Heat transfer. Thermal power plants (boilers, furnaces and compressor units).  Energy Act. Electrical Code. Terms of occupational health and safety in the energy sector.  Main technological processes in the power industry.  Implementation of individual assignments.  Conclusions and suggestions for practice. |
| The results of training / exams / exams forms: | Calculated and graphic works, defense of report on practice, computer test |
| Technical / multimedia tools: | Multimedia complex, interactive board |
| References: | 1. Heat engineering. Edited by V.N. Lukanina. – М.: High school, 2005. 2. Apalkov А.F. Heat engineering. – Rostov n/D.: Fenix, 2008. 3. Kudinov V.A., Kartashov E.M. Technical Thermodynamics. – М.: High school., 2000; 4. Legislative and normative acts of the RK in the field of power engineering. 5. Guidelines for production practice. |

# 15. Industrial electronics

|  |  |
| --- | --- |
| Term of study: | 5 |
| Person responsible for the module | Kashevkin А.А. |
| Lecturer: | Kashevkin А.А. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  5th semester: hours per week – 6;  per semester – 90. |
| Workload: | Full-time:  Curricular load: 30 hours  Extracurricular load: 60 hours  Total: 90 hours |
| Credit points: | 3 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Basics of mathematics, Physics, Computer science, Electrotechnics. |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge of basics of design, work principles and operation of power engineering objects;  be competent in the use of analog and digital, electrical and electronic technologies. |
| Contents: | Power semiconductor devices.  Amplifiers.  Pulse technique.  Digital technology.  Single-phase rectifiers.  Three-phase rectifiers.  Single-phase and three-phase controlled rectifiers.  Inverters, led network.  Frequency converters.  Switching Converters DC.  Stand-alone inverters. |
| The results of training / exams / exams forms: | Computer test |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory brenches |
| References: | 1. Zabrodin Yu.S. Inductrial electronics. - М.: Alyans, 2008. 2. Popkov O.Z. Основы преобразовательной техники.- М.: Publishers of MEI, 2005. 3. Rozanov Yu.K., Ryabchitskiy M.V., Kvasnyuk А.А. Power electronics. - М: Publishers of MEI, 2009. 4. Rama Reddi S. SBasics of power electronics. - М.: Technospera, 2006. |

# 16. Electrical Machines

|  |  |
| --- | --- |
| Term of study: | 5 |
| Person responsible for the module | Shatkovskaya N.V. |
| Lecturer: | Shatkovskaya N.V. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  5th semester: hours per week – 10;  per semester – 150. |
| Workload: | Full-time:  Curricular load: 50 hours  Extracurricular load: 100 hours  Total: 150 hours |
| Credit points: | 5 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Basics of mathematics, Physics, Computer science, Electrotechnics |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge of basics of design, work principles and operation of power engineering objects |
| Contents: | Design and operation of the transformer. Working the transformer under load. Function and structure constructive generators and DC motors. The main types of AC machines and their device. Armature winding AC machines. Fundamentals of the theory of induction machines. Synchronous machines. |
| The results of training / exams / exams forms: | Computer test |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory brenches |
| References: | 1. Voldek A.I., Popov V.V. Electric machines. Introduction to electrical engineering. DC machines and transformers. – SPb,: – Piter, 2007.-320 pp. 2. - Voldek A.I., Popov V.V. Electric machines. AC machine. – SPb,: – Piter, 2007.-350 pp. |

# 17. Materials Study

|  |  |
| --- | --- |
| Term of study: | 3 |
| Person responsible for the module | Zykova N.V. |
| Lecturer: | Basics of Materials study – Zykova N.V.,  Electrical Materials study – Zykova N.V.,  Fundamentals of Nanotechnologies – Latypov S.I.,  Electrical insulation devices – Latypov S.I. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  3rd semester: hours per week – 12;  per semester – 180. |
| Workload: | Full-time:  Classroom load: 60 hours  Extracurricular workload: 120 hours  Total: 180 hours |
| Credit points: | 6 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Сhemical properties of materials. Physics. |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge in natural sciences and mathematics;  demonstrate knowledge of basics of design, work principles and operation of power engineering objects. |
| Contents: | Construction materials;  Composite materials;  Nanomaterials;  Semiconductor materials;  Conducting materials;  Dielectric materials;  Magnetic materials;  Nanoscience and Nanotechnology;  Measurement methods in nanotechnology. |
| The results of training / exams / exams forms: | Test and oral examination |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory benches |
| References: | 1. Silman G.I. Materials Study. - М.:Academiya, 2008. 2. Volkov G.M., Zuev V.M. Materials Study. – М.: Academiya, 2008. 3. Moryakov О.S. Materials Study. – М.: Academiya, 2008. 4. Lozovskiy V.N., Konstantinova G.S., Lozovskiy S.V. Nanotechnologies in electronics. Introduction to the profession. –Lan, 2008. 5. Nanomaterials. Nanotechnologies. Nanosystems engineering. Edited by Malceva P.P. – М.: Technospere, 2006. 6. Nanotechnologies in electronics. Edited by Chaplygin Yu.A. – М.: Technospere, 2005. |

# 18. Electronics and modeling

|  |  |
| --- | --- |
| Term of study: | 3 |
| Person responsible for the module | Latypov S.I. |
| Lecturer: | Computer graphics – Latypov S.I.,  Computer simulation – Latypov S.I.,  Basics of Electronics – Latypov S.I.,  Elements of Electronic Engineering – Latypov S.I. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  3rd semester: hours per week – 12;  per semester – 180. |
| Workload: | Full-time:  Curricular load: 60 hours  Extracurricular load: 120 hours  Total: 180 hours |
| Credit points: | 6 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Basics of mathematics, Physics, Computer science. |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate skills in the use of software for computing, simulation and implementation of industrial technologies;  be competent in the use of analog and digital, electrical and electronic technologies. |
| Contents: | Passive electronic components.  Semiconductors.  Amplifiers and feedback.  Filters.  Generators.  Types and methods of modulation.  Application PC to solve the problems of design and analysis of electrical circuits.  Making design documentation. |
| The results of training / exams / exams forms: | Calculated and graphic works, test and oral examination |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory benches, computer class. |
| References: | 1. K.S.Petrov. Radio materials, datasheets and electronics. St. Petersburg, 2003; 2. V.I.Lachin., N.S.Savelov. Electronics. Rostov n/D, 2002; 3. S.T.Usatenko. Making the electrical circuits on CSDD: Handbook. – М.: Publisher standards, 1989; 4. I.Chernych. Modeling of electrical devices in MATLAB, SimPowerSystems and Simulink. – М.: ID Piter, 2007; 5. A.S.Zhuravlev. AutoCAD for designers. CSDD standards in AutoCAD 2009/2010/2011. Practical advices of designer. - M.: Science and Technology, 2010; 6. I.I.Aliev. Virtual Electrical Engineering. Computer technology in electrical engineering and electronics. - Kiev: RadioSoft, 2003. |

# 19. Automatics

|  |  |
| --- | --- |
| Term of study: | 4 |
| Person responsible for the module | Zykova N.V. |
| Lecturer: | Basics of automation – Zykova N.V.,  Automatic control – Zykova N.V.,  Sensors of technological processes – Dariy E.M.,  Transducers of measuring signals - Dariy E.M. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  4th semester: hours per week – 16;  per semester – 240. |
| Workload: | Full-time:  Curricular load: 80 hours  Extracurricular load: 160 hours  Total: 240 hours |
| Credit points: | 8 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module. |
| Recommended conditions: | Basics of mathematics, Physics, Computer science, Materials Study |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge in the metrological provision of instruments and systems;  be competent in the use of analog and digital, electrical and electronic technologies. |
| Contents: | Basic concepts of automation. Functional diagrams. Basic elements of automated systems. Indicators of the quality of regulation. Sensors for general industrial use. Relays and valves. Typical relay circuits. Automatic switching devices. Electromechanical actuators and mechanisms.  Classification of asymptotic equiprobability property (AEP). Description of AEP in the frequency domain. AEP resistance. Assessment of the quality and increase the accuracy of the AEP. Synthesis of AEP.  General information about the sensors and measuring systems. Classification sensors. Generator and parametric sensors. Sensors of electrical quantities. Sensors of non-electrical quantities. Sensors materials and manufacturing techniques. Key switching circuits of sensors. Amplifiers sensor signals. The display device. |
| The results of training / exams / exams forms: | Test and oral examination, defense of course paper. |
| Technical / multimedia tools: | Control and measurement equipment, instruments of specialized laboratory classrooms, advanced multimedia complexes. |
| References: | 1. Shishmarev V.Yu. Automatics. М.: Academiya, 2005. 2. Kelim Yu.M. Typical elements of automatic control systems. М.: Academiya, 2005 3. Topilskiy V.B. Circuitry of measuring devices. – М.: BINOM. Laboratory of knowledge, 2010. 4. Mukhanin L.G. Circuitry of measuring devices. - М.: Lan, 2009. 5. Kotyuk A.F. Sensors in modern measurements. - М.: Radio and communication, Hot line - Telecom, 2006. 6. [Klaasen K.](http://lib.nkzu.kz/cgi/irbis64r_01/cgiirbis_64.exe?Z21ID=&I21DBN=KNIGI&P21DBN=KNIGI&S21STN=1&S21REF=3&S21FMT=fullwebr&C21COM=S&S21CNR=20&S21P01=0&S21P02=1&S21P03=A=&S21STR=%D0%9A%D0%BB%D0%B0%D0%B0%D1%81%D1%81%D0%B5%D0%BD%20%D0%9A.) Basics of measurements. Sensors and electronic devices. Teaching aid. - Dolgoprudniy: Intellect, 2008. 7. [Jekson R.G.](http://lib.nkzu.kz/cgi/irbis64r_01/cgiirbis_64.exe?Z21ID=&I21DBN=KNIGI&P21DBN=KNIGI&S21STN=1&S21REF=3&S21FMT=fullwebr&C21COM=S&S21CNR=20&S21P01=0&S21P02=1&S21P03=A=&S21STR=%D0%94%D0%B6%D0%B5%D0%BA%D1%81%D0%BE%D0%BD%20%D0%A0.%D0%93.) The latest sensors. - М: Technosphere, 2008. 8. Rotach V.Ya. Automatic Control Theory.- М.:-MEI, 2004. 9. Lazareva Ya., Martemyanov Yu.F. Linear systems of automatic control. Tver State Technical University. Teaching aid. Tver, 2006. |

# 20. Basics of electrical equipment operation

|  |  |
| --- | --- |
| Term of study: | 4 |
| Person responsible for the module | Smirnova O.P. |
| Lecturer: | Electrical Safety - Zykova N.V.,  Industrial Safety - Zykova N.V.,  Foundations of reliability theory – Smirnova O.P.,  Electromagnetic compatibility – Smirnova O.P. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  4th semester: hours per week – 12;  per semester – 180. |
| Workload: | Full-time:  Curricular load: 60 hours  Extracurricular load: 120 hours  Total: 180 hours |
| Credit points: | 6 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Сhemical properties of materials. Physics. Basics of profession. |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge of basics of design, work principles and operation of power engineering objects;  demonstrate knowledge in the metrological provision of instruments and systems;  demonstrate skills of assessment of technical condition and remaining life of the electric power engineering equipment. |
| Contents: | Danger of electric shock to persons;  First aid to victims of the electric current;  General safety requirements for maintenance of electrical installations;  Security measures for electrical disrepair;  Electricity means.  Reliability theory and its basic concepts and definitions;  Reliability criteria of recoverable and non-recoverable systems;  Indicators of reliability of the components and systems;  Basic information about electromagnetic compatibility;  Sources of electromagnetic interference, classification;  Methods of description and presentation of interference;  Penetration mechanism interference (parasitic channels);  Galvanic, capacitive, inductive influence;  Exposure to electromagnetic radiation;  Passive suppression and protective components, shielding; |
| The results of training / exams / exams forms: | Computer test, oral examination |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory benches |
| References: | 1. Monakhov A.F. Protective measures of electrical safety in electric installations. Teaching aid. М.; ZAO «Energoservis», 2008. 2. Sibikin Yu.D. Electrical safety in the operation of electrical industrial enterprises: М.; Publishers centre «Academiya», 2008. 3. Polovko А.М., Gurov S.V. Fundamentals of reliability theory. –– Spb. BHV-Peterburg, 2006 4. Polovko А.М., Gurov S.V. Fundamentals of reliability theory.Practice. –Spb. BHV-Peterburg, 2006 5. Aleksandrovskaya L.N., Afanasev A.P., Lisov А.А. Modern methods of ensuring reliability of complex technical systems: –М.: Logos,2003 6. Ostreykovskiy V.A. Reliability theory:– М.: High school., 2003 7. Devisilov V.A. Labor protection. – М.:FORUM:INFRA-М, 2005 |

# 21. Basics of Economic Studies

|  |  |
| --- | --- |
| Term of study: | 4 |
| Person responsible for the module | Terekhin A.N. |
| Lecturer: | Terekhin A.N. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  4th semester: hours per week – 6;  per semester – 90. |
| Workload: | Full-time:  Curricular load: 30 hours  Extracurricular load: 60 hours  Total: 90 hours |
| Credit points: | 3 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | This module is based on knowledge of students, acquainted at secondary school while studying “History of Kazakhstan”, “Geography”. |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate skills in organization of works of enterprises of power branch;  be able to formulate the main technical and economic requirements to the projected devices and systems;  be able to apply basic techniques of marketing and management in the field of instrument engineering |
| Contents: | Discipline forms knowledge on topical theoretical and applied problems of economics, acquaints with technical and economic indicators of enterprises’ work and promotes the understanding of economic and social phenomena |
| The results of training / exams / exams forms: | Examination in computer test form |
| Technical / multimedia tools: | Multimedia complex |
| References: | 1. Kaznachevskaya G.B. Economic theory. – Rostov-na-Donu: Fenix, 2010. – 346 pp.; 2. Nosova S.S. Economic theory. – М.: KNORUS, 2009. – 312 pp.; 3. Simkina L.G. Economic theory. – SPb.: Piter, 2010. – 384 pp.; 4. Terekhin A.N. Economic theory: Lectures course. – Petropavlovsk: NKSU named after M.Kozybayev. 2012. – 151 pp.   5. Yanova V.V. Economic theory. – М.: Eksmo, 2009. – 512 pp. |

# 22. Switching devices in Electric Power Engineering

|  |  |
| --- | --- |
| Term of study: | 5, 6 |
| Person responsible for the module | Latypov S.I. |
| Lecturer: | Relay Protection of Electric Power Systems – Latypov S.I.,  Elements of automation and relay protection – Latypov S.I.,  Transient processes in Electric Power Systems – Latypov S.I.,  Insulation and overvoltage in electrical installations – Latypov S.I.,  Switching equipment – Kashevkin А.А.,  Power converter device – Kashevkin А.А. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  5th semester: hours per week – 6;  per semester – 90.  6th semester: hours per week – 12;  per semester – 180. |
| Workload: | Full-time:  Curricular load: 90 hours  Extracurricular load: 180 hours  Total: 270 hours |
| Credit points: | 9 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Basics of mathematics. Physics. Electrotechnics. Electronics and modeling. Automatics. Basics of electrical equipment operation. Technological processes in power engineering. |
| The objectives of the module/ Expected learning outcomes: | Student must:  be able to use scientific-research methods in order to create new energy devices and systems;  demonstrate knowledge of basics of design, work principles and operation of power engineering objects;  be competent in design, maintenance and operation of distribution networks of 10-220 kV class. |
| Contents: | Assignment of relay protection and basic requirements; RPA devices on microelectronic basis; Current and voltage transformers; Protection lines, transformers, electric motors; Automatic grid; Cabinets of relay protection and automation;  AC switchers; Disconnectors; Shorting plugs; Separators; Fuses; Arresters and surge arresters; Transducers and wiring diagrams;  Quality of electricity in supply systems of objects; Automation and relay protection in power systems facilities; Automatic generators normal operating modes; Emergency automation control of power systems; Classification and description of interference;  Purpose and main types of electrical insulation; Principles of construction of internal insulation; Storm Surge and lightning protection of electrical installations; Internal surge in electrical systems with long transmission line; Insulation coordination on the level of domestic and storm surges; Rectifiers and inverters; Frequency converters; Pulse width converters. |
| The results of training / exams / exams forms: | Calculated and graphics works, test and oral examination. |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory benches |
| References: | 1. V.N.Kop’ev. Relay protection. Tomsk, 2001; 2. B.A.Alekseev. Maintenance of relay protection and automatic power plants and electric networks. Part 1. Electromagnetic relay. Edited by М. NTs ENAS, 2000; 3. Guidance on the calculation of short-circuit and selection of electrical Rd 153-34.0-20.527-98 Russian Joint Stock Company for Energy and Electrification "UES of Russia" Moscow "Publishers NTs ENAS", 2001; 4. Bader M.P. Electromagnetic compatibility. - М.: Transport, 2002; 5. Karyakin R.N. Electrical grounding devices. Handbook. The second edition. М.; Energoservis. 2006; 6. Zinov’ev G.S. Power electronics. – SPb,: Yurait, 2012. 7. Pronin M.V., Vorontsov A.G. Power fully controllable semiconductor converters (modeling and calculation). – М.: Electrosila, 2003. |

# 23. Design of electrical systems

|  |  |
| --- | --- |
| Module Title: |  |
| Term of study: | 5, 6 |
| Person responsible for the module | Latypov S.I. |
| Lecturer: | Foundations of energy saving – Latypov S.I.,  Alternative and renewable energy sources – Latypov S.I.,  Electrical systems and networks – Shatkovskaya N.V.,  Modes of power systems – Kashevkin А.А. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  5th semester: hours per week – 6;  per semester – 90.  6th semester: hours per week – 8;  per semester – 120. |
| Workload: | Full-time:  Curricular load: 70 hours  Extracurricular load: 140 hours  Total: 210 hours |
| Credit points: | 7 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Physics. Interaction of human and environment. Electrotechnics. Basics of electrical equipment operation. |
| The objectives of the module/ Expected learning outcomes: | Student must:  be ready to use scientific-research methods in order to create new energy devices and systems;  demonstrate knowledge of basics of design, work principles and operation of power engineering objects;  demonstrate knowledge in the metrological maintenance of electrical installations;  be competent in the use of analog and digital, electrical and electronic technologies;  demonstrate skills of assessment of technical condition and remaining life of the electric power engineering equipment;  be competent in design, maintenance and operation of distribution networks of 10-220 kV class;  be competent in evaluating operation modes of electricity networks. |
| Contents: | Structure and function stations using alternative and renewable energy sources: wind, solar, tides, geothermal energy, energy of the magnetic field of the earth, biomass. Development prospects.  General concepts of power systems and electrical networks. Structural elements of overhead power lines and cables. Calculation of the operating modes of open and closed simple electrical networks. Value of electric power and voltage regulation in electric networks.  Modes of operation of the main equipment of power plants and substations.  Emergency, normal, transient and steady-state modes. |
| The results of training / exams / exams forms: | Calculated and graphics works, test and oral examination |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory benches |
| References: | 1. J.Twaidel. Renewable energy sources. М, 2009; 2. L.I.Kuperman. Secondary energy resources and energotechnological combining industry. Kiev, 2006; 3. V.N.Sazhin «Electric systems and networks», thesis of lectures AIES,2004., Almaty; 4. K.K.Tokhtibakiev. «Electric systems and networks». Methods for calculating the losses and electricity rationing. Almaty,2005; 5. I.М. Markovich. Modes of energy systems. – М.: Energiya, 2009. |

# 24. Metrological provision of electrical equipments

|  |  |
| --- | --- |
| Term of study: | 5 |
| Person responsible for the module | Smirnova O.P. |
| Lecturer: | Technical Metrology – Smirnova O.P.,  Information and Measuring Equipment – Smirnova O.P. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  5th semester: hours per week – 6;  per semester – 90. |
| Workload: | Full-time:  Curricular load: 30 hours  Extracurricular load: 60 hours  Total: 90 hours |
| Credit points: | 3 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Basics of mathematics, Physics, Electrotechnics. |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge of basics of design, work principles and operation of power engineering objects;  demonstrate knowledge in the metrological maintenance of electrical installations;  demonstrate skills of assessment of technical condition and remaining life of the electric power engineering equipment;  be competent in design, maintenance and operation of distribution networks of 10-220 kV class;  demonstrate skills of design, maintenance and operation of electrical substations;  be competent in evaluating operation modes of electricity networks |
| Contents: | Specifications of measuring instruments;  Processing of measurement results;  Cathode-ray oscilloscope and metrologyof oscilloscope measurements;  Electromechanical instrumentation;  Electronic measuring instruments;  Digital instrumentation;  Analog-to-digital converters and digital voltmeters;  Means for measuring the frequency, time intervals, and the phase shift;  Means for measuring the parameters of circuits with lumped;  Information recording means in the measurements;  Measuring Information Systems;  Typical structural scheme of technological means of measurement;  Pressure and temperature measurement;  Measuring the level of the liquid and the volatile materials;  Measurement of the composition and properties of the fluid;  Devices and systems for environmentaland industrial emissions monitoring |
| The results of training / exams / exams forms: | Computer test, oral examination |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory benches |
| References: | 1. Law of the Republic of Kazakhstan "On the Unity of Measurements" 2. Atamalyan E.G. Instruments and methods for measuring of electrical quantities.- М.: Drofa, 2005; 3. Panfilov V.A. Electric measurements - М.: Publishers centre "Academiya", 2006; 4. T.S.Ratkhor Digital measurements. Methods and circuit. Moscow: Technosfera;2008 5. Khart Kh. Introduction to the measuring technique - М.: Publishers "Мir", 2005.; 6. Information and measuring equipment/edited by G.G.Ranneva – М.: High school, 2002. 7. Kelim Yu.M. Typical elements of the automated control systems.-М.:Forum:infaM.2002 8. Kuznetsov N.D., Chistyakov V.S. Collection of tasks and questions for Heat Engineering Measurements and Instruments. -М.:Energopromizdat,2005. 9. Talanov V.D. Technical means of automation.-2nd edition: Isto-servis,2002 |

# 25. Advanced directions of development of electric power engineering and electrotechnical equipments

|  |  |
| --- | --- |
| Term of study: | 5 |
| Person responsible for the module | Kashevkin А.А. |
| Lecturer: | Electromechanics – Kashevkin А.А.,  Electrotechnical equipment – Kashevkin А.А.,  Electric Power Engineering – Shatkovskaya N.V.,  General energy issues - Shatkovskaya N.V. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  5th semester: hours per week – 14;  per semester – 210. |
| Workload: | Full-time:  Curricular load: 70 hours  Extracurricular load: 140 hours  Total: 210 hours |
| Credit points: | 7 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Basics of mathematic. Physics. Electrotechnics. Electronics and modeling. Automatics. Basics of electrical equipment operation. Technological processes in power engineering. Materials Study. |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate skills of design, maintenance and operation of electrical substations;  be able to formulate the main technical and economic requirements to the projected devices and systems;  demonstrate knowledge of basics of design, work principles and operation of power engineering objects;  be competent in design, maintenance and operation of distribution networks of 10-220 kV class;  preparedness to use scientific-research methods in order to create new energy devices and systems |
| Contents: | Theoretical Foundations of Electromechanics;  Conversion of energy into electrical machines;  Insulating and cable machinery;  Electrotechnological devices and systems;  Lighting fixtures and light sources;  Electric drive and automation of technological complexes;  Tendencies of development of legislative base energy, energy resources of the Republic of Kazakhstan, the ways and means of converting them into electrical energy, the principles of transmission, distribution of energy, methods of automatic elimination of damage and abnormal conditions in the electrical part of power systems, power supply on branches;  Use of non-oil energy sources - wind, solar radiation, the energy of the seas, thermal waters |
| The results of training / exams / exams forms: | Calculated and graphics works, examination in test and oral forms. |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory benches |
| References: | 1. Goldberg O.D. Electromechanics: М.: Publishers centre «Academiya», 2007; 2. Vol’dek A.I., Popov V.V. Electric machines. Introduction to ekectromechanics. DC machines and transformers. – SPb,: – Piter, 2007.-320 pp. 3. Kopylov I.P. Electric machines. - М.: HS, 2010; 4. Shekhovtsov V.P. Electrical and electromechanical equipment. - М: Forum: Infra-М, 2008; 5. Reference book for the design of electric lighting / G.M. Knorring, I.M.Fadin, V.N.Sidorov. - SPb: Energoatomizdat, 2008; 6. Moskalenko V.V. Automated control system for electric drive. - М: Forum: Infra-М, 2004; 7. Bystritskiy G.F. General power engineering, М.: Academiya, 2005 8. Rozhkova L.D. Electrical equipment of power stations and substations, М.: Academiya, 2004 9. Basics of modern power engineering. Edited by E.V.Ametistova. М.: Publishers MEI. 2003 10. Alekseev B.A. Basic equipment in power systems, М.: Publishers NTs ENAS, 2002 |

# 26. Design and operation of power plants and substations

|  |  |
| --- | --- |
| Term of study: | 5 |
| Person responsible for the module | Latypov S.I. |
| Lecturer: | Power stations and substations – Latypov S.I.,  Equipment of power stations and substations – Latypov S.I.,  Maintenance of power stations and substations – Latypov S.I.,  Organization of repair work – Latypov S.I. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  5th semester: hours per week – 12;  per semester – 180. |
| Workload: | Full-time:  Curricular load: 60 hours  Extracurricular load: 120 hours  Total: 180 hours |
| Credit points: | 6 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Basics of mathematics. Physics. Electrotechnics. Electronics and modeling. Automatics. Basics of electrical equipment operation. Technological processes in power engineering. Materials Study. Computer graphics. |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate skills of design, maintenance and operation of electrical substations;  be competent in the use of analog and digital, electrical and electronic technologies;  demonstrate skills of assessment of technical condition and remaining life of the electric power engineering equipment;  demonstrate skills of design, maintenance and operation of electrical substations |
| Contents: | General information about the work of the electrical system.  The method of constructing the annual load curve.  Types of plants and basic quantities characterizing the station.  Synchronous generators and their nominal values​​.  Excitation system and automatic extinguishing magnetic field synchronous generators.  Power transformers and autotransformers.  Major electrical equipment.  Organization of maintenance and repair of electrical equipment. Electrical safety in the organization of maintenance and repair of electrical equipment. Maintenance of electrical equipment. Repair of electrical equipment |
| The results of training / exams / exams forms: | Test and oral examination, defense of course paper |
| Technical / multimedia tools: | Multimedia complex, computer class, specialized labs |
| References: | 1. Abzhanov R.S. Electric part of station. Thesis of lecture. Almaty, AIES, 2009 2. Khozhin G.Kh. Electric part of electric station. Almaty, AIES, 2009 3. Rozhkova L.D. Electric equipment of power stations and substations.М.: Academiya, 2004 4. Bystratskiy G.F. General power engineering. М.: Academiya, 2005 5. Basis of modern power engineering. Edited by E.V. Ametistova. М.: Publishers MEI, 2003 |

# 27. Technical equipment of energy facilities

|  |  |
| --- | --- |
| Term of study: | 6 |
| Person responsible for the module | Latypov S.I. |
| Lecturer: | Electrical devices - Kashevkin А.А.,  Electromechanical and electronic relays and automation devices – Latypov S.I.,  Production practice – Latypov S.I. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  6th semester: hours per week – 6;  Production practice – 120;  per semester – 210. |
| Workload: | Full-time:  Curricular load: 30 hours  Extracurricular load: 60 hours  Production practice: 120 hours  Total: 210 hours |
| Credit points: | 7 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Basics of mathematics. Physics. Electrotechnics. Advanced directions of development of electric power engineering and electrotechnical equipments. Switching devices in electric power engineering. Design and operation of power plants and substations. |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge of basics of design, work principles and operation of power engineering objects;  demonstrate knowledge in the metrological maintenance of electrical installations;  demonstrate skills in the use of software for process calculating and modeling in electric power engineering systems;  demonstrate skills of assessment of technical condition and remaining life of the electric power engineering equipment;  demonstrate skills of design, maintenance and operation of electrical substations. |
| Contents: | Electromechanical devices of electric power distribution systems.  Thermal processes in electrical apparatus. Electrical contacts.  Electric arc and the commutation process.  Breakers and disconnectors.  Control apparatus.  Electromagnetic mechanisms.  Electromechanical relays.  Electromagnetic contactors and magnetic starters.  Electronic relays.  Company structure, internal regulations.  Organization of the work of repair and maintenance of electrical equipment in the enterprise.  Implementation of individual assignments.  Conclusions and suggestions for practice. |
| The results of training / exams / exams forms: | Test and oral examination, report on practice |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory benches |
| References: | 1. Aliev I.I., Abramov M.B. Electric apparatus. Handbook-М: radio soft, 2004. 2. Chunkhin А.А. Electric apparatus. – М.: Energoatomizdat, 2005 3. Rodsteyn L.А. Electric apparatus. – М.: Energoatomizdat, 2005. 4. Rozanov Yu.K., etc. Electric and electronic apparatus. -М,: Informelectro,2001. 5. Shabad М.А. Calculations of relay protection and automation of distribution networks. – М.: SPb.: IEIPK, 2003. 6. Andreev V.A. Relay protection of power supply systems in the examples and tasks. М.: HS 2008. 7. Bass E.I., Doroguntsev V.G. Relay protection of electric power systems. - М: MEI, 2006. 8. Guidelines on production practice. |

# 28. Electricity supply

|  |  |
| --- | --- |
| Term of study: | 6 |
| Person responsible for the module | Kashevkin А.А. |
| Lecturer: | Electricity supply of industrial enterprises – Kashevkin А.А.,  Electricity supply of facilities – Kashevkin А.А. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  6th semester: hours per week – 8;  per semester – 120. |
| Workload: | Full-time:  Curricular load: 40 hours  Extracurricular load: 80 hours  Total: 120 hours |
| Credit points: | 4 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Electrotechnics. Materials Study. Advanced directions of development of electric power engineering and electrotechnical equipments. Design and operation of power plants and substations. |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate preparedness to use scientific-research methods in order to create new energy devices and systems;  demonstrate knowledge of basics of design, work principles and operation of power engineering objects;  demonstrate knowledge in the metrological maintenance of electrical installations;  be competent in the use of analog and digital, electrical and electronic technologies;  be competent in design, maintenance and operation of distribution networks of 10-220 kV class;  demonstrate skills of design, maintenance and operation of electrical substations;  demonstrate skills of working in groups to create power supply projects. |
| Contents: | The wiring diagrams in the electricity system;  In-plant and intrashop electricity supply of industries;  Electrical loads;  Reactive power compensation in electricity supply system;  Selecting devices and conductors of the electricity supply system of voltage up to 1 kV and above;  Quality of electricity in electricity supply systems of objects. |
| The results of training / exams / exams forms: | Calculated and graphics works, defense of course paper, test and oral examination. |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory benches |
| References: | 1. Kudrin B.I. Electricity supply of industries. - М.: Intermet Inzhiniring, 2005; 2. Shekhovtsev V.P.Calculation and design of electricity supply circuits. - М: Forum: Infra-М, 2004; 3. Konyukhova Е.А. Electricity supply of objects. - М.: Academiya, 2006; 4. Sibikin Yu.D. Electrical supply of industrial and civil buildings. - М.: Academiya, 2006. |

# 29. Microprocessor electronics

|  |  |
| --- | --- |
| Term of study: | 6 |
| Person responsible for the module | Savostin А.А. |
| Lecturer: | Digital devices and microprocessors – Savostin А.А.;  Microprocessors and microcontrollers in electric power engineering – Savostin А.А. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  6th semester: hours per week – 6;  per semester – 90. |
| Workload: | Full-time:  Curricular load: 30 hours  Extracurricular load: 60 hours  Total: 90 hours |
| Credit points: | 3 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Basics of mathematics. Electronics and modeling. |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate skills in the use of software for process calculating and modeling in electric power engineering systems;  be competent in the use of analog and digital, electrical and electronic technologies. |
| Contents: | Arithmetic basics of digital technology. Combinational digital devices. Sequential digital devices. Purpose, basic parameters, classification of storage devices (memory). Read-only memories. Types of ROM. Analog-to-digital and digital-to-analog converters. General information about microprocessors. Organization of information exchange. Architecture of typical microprocessor. Elements of software management of computer devices. |
| The results of training / exams / exams forms: | Calculated and graphics works, test and oral examination |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory benches |
| References: | 1. Ugryumov E.P. Digital circuit technology. SPb.: BVKh-Sankt-Peterburg, 2000. 2. Kuchumov A.I. Electronics and circuit technology. М.:, «Gelios ARV», 2001. 3. Gol’denberg L.M., etc. Digital devices and microprocessor systems. Tasks and exercises:М.: Radio i svyaz’,2002. 4. Pukhalskiy G.I., Novosel’tseva T.Ya. Digital devices: SPb.: Politekhnika, 2006. 5. Karlashuk V.I. Electronic lab in IBM PC. Program Electronics Workbench and its usage. М.: SOLON-R, 2000. |

# 30. Advanced language training

|  |  |
| --- | --- |
| Term of study: | 6 |
| Person responsible for the module | Aubakirova S.S. |
| Lecturer: | Professional Kazakh language – Kuandykova D.  Foreign language (professional) - Aubakirova S.S. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  6th semester: hours per week – 12;  per semester – 180. |
| Workload: | Full-time:  Curricular load: 60 hours  Extracurricular load: 120 hours  Total: 180 hours |
| Credit points: | 6 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Foreign language. State language |
| The objectives of the module/ Expected learning outcomes: | Student must:  have basic skills to analyze the relationship of culture, morality and religion;  demonstrate communication skills;  be able to express orally or in written form own ideas and variants of solving problems in several languages. |
| Contents: | Describing professional competence; personal and professional challenges; professional image of contemporary an instrument-making engineers; the importance to be skilled; decision-making process; business meetings and correspondence.  Grammar review.  Listening and speaking.  The course’s content is focused on formation skills  - basic skills to analyze the relationship of culture, morality and religion through studying themes of “Country-specific studies”;  - communication skills through studying “Man and society”;  - expressing linguistic knowledge in written or oral forms through writing essay, stories and studying dialogue and monologue speech. |
| The results of training / exams / exams forms: | Test and oral examination |
| Technical / multimedia tools: | Multimedia complex, interactive board. |
| References: | 1. Philip Kerry, Ceri Jones. Straight Forward Elementary student’s book, Macmillian Publishers Limited, 2010  2. Philip Kerry, Ceri Jones. Straight Forward Intermediate student’s book, Macmillian Publishers Limited, 2010  3. Philip Kerry, Ceri Jones. Straight Forward Upperintermediate student’s book, Macmillian Publishers Limited, 2010  4. Samoylova E.V., Novoselova O.V. Collection of texts for engineering specialties in English: teaching-methodological aid.- Petropavlovsk: NKSU named after M.Kozybayev, 2009.  5. Novoselova O.V. English for the Development of Professional Communicative Skills for Engineering specialties: teaching-methodological aid.- Petropavlovsk: NKSU named after M.Kozybayev,2013.  6. TMCD on discipline “Professional Kazakh language”/Т.A.Аkhmetova, B.Т. Mukanova, K.K. Taimullina. – Petropavlovsk: NKSU named after M.Kozybayev, 2013. - 57 pp.  7. Teaching students of engineering specialties to communicate professionally. teaching-methodological aid/ D.Kuandykova. - Petropavlovsk: NKSU named after M.Kozybayev, 2013. - 101 pp.  8. Development of professional language of students of agricultural specialties through special texts: teaching-methodological aid/Т.Akhmetova. - Petropavlovsk: NKSU named after M.Kozybayev, 2013. –102 pp.  9. Professional Kazakh language. Electronic lessons system for Information systems specialty: teaching-methodological aid /Zh.Koshanova. – Petropavlovsk: NKSU named after M.Kozybayev, 2013. - 110 pp.  10. Professional Kazakh language: methodological aid for mathematics specialty./ S.Zh.Zhuanyshpaeva. - Petropavlovsk: NKSU named after M.Kozybayev, 2013. - 109 pp.  11. Professional Oriented Kazakh language: teaching-methodological aid for students of jurisprudence, geography, pedagogic faculties. - Petropavlovsk: NKSU named after M.Kozybayev, 2014. - 256 pp.  12. Professional Kazakh language: collection of texts for students of Computer science specialty. / S.Zh.Zhuanyshpaeva. - Petropavlovsk: NKSU named after M.Kozybayev, 2012. – 83 pp. |

# 31. Production and distribution of electric power

|  |  |
| --- | --- |
| Term of study: | 7, 8 |
| Person responsible for the module | Dariy Е.М. |
| Lecturer: | Power Generation – Dariy Е.М.,  The reliability and quality of electricity – Latypov S.I.,  Power Transmission and Distribution – Latypov S.I.,  High Voltage Products – Kashevkin А.А.,  Production practice– Latypov S.I. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  7th semester: hours per week – 20;  per semester – 300.  8th semester: Production practice – 150. |
| Workload: | Full-time:  Curricular load: 100 hours  Extracurricular load: 200 hours  Production practice: 150 hours  Total: 450 hours |
| Credit points: | 15 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Electrotechnics. Materials Study. Switching devices in electric power engineering. Advanced directions of development of electric power engineering and electrotechnical equipments. Design and operation of power plants and substations. |
| The objectives of the module/ Expected learning outcomes: | Student must:  be able to apply basic techniques of marketing and management in the field of Power Engineering;  be ready to use scientific-research methods in order to create new energy devices and systems;  demonstrate knowledge of basics of design, work principles and operation of power engineering objects;  demonstrate knowledge in the metrological maintenance of electrical installations;  be competent in the use of analog and digital, electrical and electronic technologies;  be competent in evaluating operation modes of electricity networks. |
| Contents: | Technological processes of production of electricity;  The electrical part of the stations;  Electric power circuits;  Power quality indicators and their impact on the operation of electrical receivers;  Methods and technical tools of power quality;  Characteristics of electrical networks and systems; Calculation and analysis of steady-state modes;  Basics of design schemes of systems of electricity transmission and distribution;  Designation and classification of high-voltage devices;  AC switches, circuit breakers, short, separators, fuses, surge arresters and surge arresters.  Company structure, internal regulations.  Implementation of individual assignments.  Conclusions and suggestions for practice. |
| The results of training / exams / exams forms: | Calculated and graphics works, defense of report on practice, computer test or oral examination. |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory benches |
| References: | 1. Ametistova E.V. Basics of modern power engineering. In 2 parts. - М.: MEI, 2002; 2. Electric part of stations and substations. Book for HEIs / edited by A.A.Vasileva. – М.: Energiya, 2000; 3. Ostreykovskiy V.A. Reliability theory. М.: High school. 2003; 4. Manage Power Quality / I.I.Kartashev, V.N.Tulskiy, R.G.Shamonov, etc.; edited by Yu.V.Sharova. – М.: Publishers house MEI, 2006; 5. Sudnova V.V. Power Quality. – М.: Energoservis, 2000; 6. Gerasimenko А.А, Fedin V.T. Transmission and distribution of electric energy. – Rostov –na-Donu: Fenix, 2006; 7. Sazhin V.N. Electrical systems and networks, thesis of lectures. Almaty: AIES, 2004; 8. Aleksandrov G.N., etc. Electric high voltage. Teaching aid for HEIs. - L.: Energoatomizadt, 2009. 9. Guidelines for production practice |

# 32. The application of electric power

|  |  |
| --- | --- |
| Term of study: | 7 |
| Person responsible for the module | Shatkovskaya N.V. |
| Lecturer: | The control circuit electrically – Kashevkin А.А.  Integrated Automation of Electric drive – Shatkovskaya N.V.  Electric drive – Shatkovskaya N.V.  Special Electric drive - Shatkovskaya N.V. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  7th semester: hours per week – 16;  per semester – 240. |
| Workload: | Full-time:  Curricular load: 80 hours  Extracurricular load: 160 hours  Total: 240 hours |
| Credit points: | 8 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Electrotechnics. Industrial electronics. Electrical Machines. Automatics. Basics of electrical equipment operation |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate abilities to apply basic techniques of marketing and management in the field of Power Engineering;  demonstrate preparedness to use scientific-research methods in order to create new energy devices and systems;  demonstrate knowledge of basics of design, work principles and operation of power engineering objects;  demonstrate knowledge in the metrological maintenance of electrical installations;  be competent in the use of analog and digital, electrical and electronic technologies. |
| Contents: | Mechanical electric drives. DC drives. Coordinate regulation of open and closed structures. AC drives. Coordinate regulation of AC drives. Converters in AC drives. Transient processes.  Automatic Electric. Typical schemes of closed-loop control of electric drives. Servo drive. Control software. Integrated automation drive. Design elements of the drive. |
| The results of training / exams / exams forms: | Course paper, computer test or oral examination |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory benches |
| References: | 1. N.F. Ilinskiy. Basics of electric drives. Publishers MEI,2003. 2. Edited by Yu.N.Petrenko. System of automated control of electric drives. М.: ACALEMA, 2005. 3. M.P.Belov, etc. Automated electric drive of model production mechanisms and technological complexes. М.: ACALEMA, 2005. |

# 33. Provision of alarm conditions control

|  |  |
| --- | --- |
| Term of study: | 7 |
| Person responsible for the module | Dariy Е.М. |
| Lecturer: | Technical means of automation of power systems – Koshekov K.Т.,  Automation of Electric Power Systems – Dariy Е.М.,  Automation and control in power systems - Shatkovskaya N.V.,  Management in electric power systems – Shatkovskaya N.V. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  7th semester: hours per week – 12;  per semester – 180. |
| Workload: | Full-time:  Curricular load: 60 hours  Extracurricular load: 120 hours  Total: 180 hours |
| Credit points: | 6 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Electrotechnics. Automatics. Switching devices in electric power engineering. Design of electrical systems. |
| The objectives of the module/ Expected learning outcomes: | Student must:  be able to apply basic techniques of marketing and management in the field of Power Engineering;  be ready to use scientific-research methods in order to create new energy devices and systems;  demonstrate knowledge of basics of design, work principles and operation of power engineering objects;  demonstrate knowledge in the metrological maintenance of electrical installations;  be competent in the use of analog and digital, electrical and electronic technologies;  be competent in design, maintenance and operation of distribution networks of 10-220 kV class;  be competent in evaluating operation modes of electricity networks. |
| Contents: | Automation components;  Technological and system automation;  The automatic control and regulation devices;  Automation of normal and emergency conditions;  Automatic speed control generators, automatic power control, voltage generators,  Auto reclosing, Automatic load, switch synchronous generators for parallel operation, automatic load shedding. |
| The results of training / exams / exams forms: | Calculated and graphics works, test and oral examination |
| Technical / multimedia tools: | Multimedia complex, interactive board, laboratory benches |
| References: | 1. Shishmarev V.Yu. Parts and accessories of automatic control systems. – М.: Academiya, 2005; 2. Ovcharenko N.I. Automatics of electric stations and electric systems: Book for HEIs / edited by A.F.Dyakova. – М.: Publishers NTs ENAS, 2003; 3. Ovcharenko N.I. Automatics of energy systems. : Book for HEIs / edited by A.F.Dyakova. – М.: Publishers house MEI, 2007; 4. Krivenkov V.V. Emergency automation. – М.: MEI, 2004; 5. Automation of Electric Power Systems / edited by V.P.Morozkina, D.Engelage. – М.: Energoatomizdat, 2004; 6. Figunov E.P. Relay protection. – М.: Transport, 2002. |

# 34. Economics in Power Engineering

|  |  |
| --- | --- |
| Term of study: | 7 |
| Person responsible for the module | Uvaleeva Zh.B. |
| Lecturer: | Economics and organization of production - Uvaleeva Zh.B.,  Economics of industry - Bykov А. А. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  7th semester: hours per week – 6;  per semester – 90. |
| Workload: | Full-time:  Curricular load: 30 hours  Extracurricular load: 60 hours  Total: 90 hours |
| Credit points: | 3 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Basics of Economic Studies, Computer science, Basics of  mathematics |
| The objectives of the module/ Expected learning outcomes: | Student must:  ability to apply basic techniques of marketing and management in the field of instrument engineering;  demonstrate skills in organization of works of enterprises of power branch;  be able to formulate the main technical and economic requirements to the projected devices and systems |
| Contents: | Economic characteristics of the power engineering industry of Kazakhstan. Electrification and the material and technical base of the country. Basic and current assets of the company. Labor resources of Company. Organization of labor in the enterprise.  Cost of production, pricing and tariffs in the energy industry. Economy of operation and repair of power. Energy accounting in industrial enterprises.  Fundamentals of Economics energy enterprises. Features of formation of costs of industrial production. Economic efficiency improving reliability of electricity of enterprises. Value and the valuation problem in industrial energy. Economy planning of energy management industry. Methods of production planning of enterprise. Planning Methods for power consumption plants. Economy of administrative decisions of energy industry facilities. Objectives and functions of management in the energy sector. Organizational structure and energy management schemes. Kazakhstan's tax system and utilities. Principles of taxation and types of taxes. Project Analysis. Technical and economic calculations at the energy sector. |
| The results of training / exams / exams forms: | Examination in computer test form |
| Technical / multimedia tools: | Computer classroom, multimedia complex. |
| References: | 1. Gitelman L.D., Ratnikov B.E. Economics and business in power engineering. An interdisciplinary book.. – М.: Economica, 2013 2. Pilyugin A.V., Sergeev S.A. Economics of Electric Power Engineering. – М.: Tonkie nauokemkie tekhnologii, 2013 3. Bushuev V.V. Energy policy. Smart electricity development involving an "active" user. – М.: Economica, 2013 4. Kuatova D.Ya. Enterprise’s economy. – Almaty: Economica, 2011 5. Taykulakova G.S. Economics and organization of production: – Almaty, 2012 6. Enterprise’s Economics: tests, tasks, situations: studies. handbook for students of economics / edited by. V.Ya.Gorfinkel’, B.N.Chernyshev. – 5th edition. – М.:Yuniti-Dana, 2009 7. Tusupbekov T., Tenizbaeva G. Enterprise’s Economics (workshop): – Astana, 2010 8. The Constitution of the Republic of Kazakhstan. Almaty, August 30, 1995. 9. Law of the Republic of Kazakhstan "On industrial safety of hazardous production facilities", Astana, April 3, 2002. 10. Labor Code of the Republic of Kazakhstan of May 25, 2007. |

# 35. Law culture

|  |  |
| --- | --- |
| Term of study: | 7 |
| Person responsible for the module | Konyrbava D.T. |
| Lecturer: | Basics of Law- Konyrbava D.T. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  7th semester: hours per week – 6;  per semester – 90. |
| Workload: | Full-time:  Curricular load: 30 hours  Extracurricular load: 60 hours  Total: 90 hours |
| Credit points: | 3 ECTS |
| Conditions for exams: | To be admitted for the examination the student must have at least 50 out of 100 points assigned for each discipline of the module |
| Recommended conditions: | Before the start of this course it’s necessary to own legal and historical knowledge that students acquire in the secondary school |
| The objectives of the module/ Expected learning outcomes: | Student must:  demonstrate knowledge of the legal, moral and ethical standards in professional activity;  have basic skills to analyze the relationship of culture, morality and religion;  demonstrate communication skills |
| Contents: | Subject, method of discipline "Law". Fundamentals of the theory of the state.  Fundamentals of the theory of law. Legal relations. Legal responsibility. Constitutional law of the RK. Administrative Law of the RK. Civil Law of the RK. Legal regulation of activities in the field of instrument engineering of the Republic of Kazakhstan. Legal responsibility for offenses in the field of instrument engineering of the Republic of Kazakhstan. Family Law of the RK. Financial Law of the RK. Labor Law of the RK. Criminal Law of the RK. General characteristics of the Environmental and Land Law of the RK. Procedural Law of the RK. |
| The results of training / exams / exams forms: | Test and oral examination |
| Technical / multimedia tools: | Multimedia complex |
| References: | 1. Dulatbekov N.O., etc. Basics of state and law of modern Kazakhstan. Astana: Foliant, 2000 2. Vengerov A.B. Theory of state and law.- М.2004. 3. Sapargaliev G. Constitutional law of the Republic of Kazakhstan. Academic course. Almaty: Zhety Zhargy, 2004 4. Civil Law of the Republic of Kazakhstan/resp. ed. Basin Yu.G., Suleymenov M.K. Academic course. Almaty:T.1,2. KazSGU, 2003. 5. Taranov А.А. Administrative Law of the Republic of Kazakhstan. Academic course. Almaty: Norma-K, 2003. 6. Ibraeva A.S., Ibraev N.S. Theory of state and law. Almaty: Zhety Zhargy, 2003. 7. Abuzyarova N.А. Labor Law: Almaty: Yurist, 2002. 8. Ospanov K.I. Basics of Law: Almaty: Zhety Zhargy, 2010 9. Kakimova M. Basics of theory of state and law: Astana: Foliant, 2010 10. Bekmagambetov A.B.., Revin V.P. Criminal law of the Republic of Kazakhstan (general and special parts): Almaty: Zhety Zhargy, 2010 11. Amirkhanova I.V. Civil law. General and special parts. Almaty: Zhety Zhargy, 2010 12. Ivanchak A.I. Labor Law. Moscow. MGIMO, 2013 13. Gricenko M.V.. Theory of state and law. Moscow: Academiya, 2013 14. Kazancev S.Ya. Basics of Law. Moscow: Academiya, 2013 15. Lobkov A.Kh, Practical use of Labor Law of the Republic of Kazakhstan. Almaty: LEM, 2013 16. Gabdualiev M.T., Zhakupov R.E. Basics of Kazakhstan’s Law. Astana: Foliant, 2013 |

# 36. Final attestation

|  |  |
| --- | --- |
| Term of study: | 8 |
| Person responsible for the module | Koshekov K.T. |
| Lecturer: | Koshekov K.T., Kashevkin А.А., Shatkovskaya N.V., Latypov S.I., Zykova N.V., Dariy Е.М. |
| Language: | Russian |
| Curriculum relation: | Ba Electric Power Engineering |
| Mode of study / number of hours per week and per term: | Full-time:  8th semester:  Pre-diploma practice – 300;  hours per semester – 750. |
| Workload: | Full-time:  Curricular load: 450 hours  Pre-diploma practice: 300 hours  Total: 750 hours |
| Credit points: | 25 ECTS |
| Conditions for exams: | Finishing of all educational programmes and writing the Bachelor’s thesis |
| Recommended conditions: | Basics of mathematics. Physics. Interaction of human and environment. Electrotechnics. Basics of electrical equipment operation. Switching devices in electric power engineering. Design of electrical systems. Industrial electronics. Electrical Machines. Metrological provision of electrical equipments. Advanced directions of development of electric power engineering and electrotechnical equipments. Design and operation of power plants and substations. Technical equipment of energy facilities. Electricity supply. The application of electric power. Production and distribution of electric power. Provision of alarm conditions control. Basics of Economic Studies. |
| The objectives of the module/ Expected learning outcomes: | Student must:  ability to apply basic techniques of marketing and management in the field of instrument engineering;  preparedness to use scientific-research methods in order to create new advanced instruments and systems;  be able to formulate the main technical and economic requirements to the projected devices and systems;  be able to express orally or in written form own ideas and variants of solving problems in several languages;  demonstrate knowledge of basics of design, work principles and operation of power engineering objects;  demonstrate knowledge in the metrological maintenance of electrical installations;  demonstrate skills in the use of software for process calculating and modeling in electric power engineering systems;  be competent in the use of analog and digital, electrical and electronic technologies;  demonstrate skills of assessment of technical condition and remaining life of the electric power engineering equipment;  be competent in evaluating operation modes of electricity networks;  demonstrate skills of design, maintenance and operation of electrical substations;  demonstrate skills of working in groups to create power supply projects;  be competent in design, maintenance and operation of distribution networks of 10-220 kV class |
| Contents: | Individual tasks on practice for each student. Registration of permits. Monitoring the implementation of students’ tasks. Check diaries and assist in the selection of materials for the report; Before the end of practice to organize work on the setting a test, sign diaries, reports and other documents on practice.  Patent-information Search on investigated theme. Selection and analysis of the electrical circuit of the object. Calculation, selection and justification of electric network elements. Calculation of short-circuit currents. Calculation of grounding. Analysis of the reliability of electricity supply, prospective profit calculation, as well as issues of labor protection and safety technique during the construction or reconstruction of power facilities. |
| The results of training / exams / exams forms: | Defense of the report. Complex state examination on specialty. Defense of Bachelor’s thesis. |
| Technical / multimedia tools: | Laboratories of the department: «Electric Power Engineering», «Information and measuring equipment», « Computer mathematics and simulation of electrical devices», «Automation of technological processes», «Basics of automatics», «Basics of automation».  Software: Electronic Workbench, Matcad, MATLAB, Proteus, S-Plan, Compass. |
| References: | 1. V.Yu. Shishmarev. Parts and accessories of automatic control systems.- М.: Academiya, 2005. 2. А.А Gerasimenko, V.Т Fedin «Transmission and distribution of electric energy» 2006. Rostov – na Donu 3. Rules of technical operation of power plants and networks / edited by A.A. Okin, М., 2001 4. V.N Sazhin «Electric systems and networks», thesis of lectures. AIES,2004., Almaty 5. K.K. Tokhtibakiev. «Electric systems and networks». Methods for calculating the electricity losses and rationing. Almaty, 2005. 6. Monakhov A.F. Protective measures in electrical installations. teaching aid. М.; ZAO «Energoservis», 2008. 7. Karyakin R.N. Electrical grounding devices. Handbook. The second edition. М.; Energoservis. 2006. 8. Sibilin Yu.D. Electrical safety in operation of electroinstallations of industrial enterprises: М.; Publishing Center "Academiya", 2008. 9. V.N. Kop’ev. Relay protection. Tomsk, 2001 10. B.A. Alekseev, Maintenance of relay protection and automatic of power plants and grids. Part 1. Electromagnetic relays. Edited by М. Publishers NTs ENAS, 2000 11. Guidance on the calculation of short-circuit and selection of electrical equipment Rd 153-34.0-20.527-98. Russian Joint Stock Company for Energy and Electrification "UES of Russia". Moscow. «Publishers NTs ENAS», 2001 12. N.F. Ilinskiy «Fundamentals of electric drive», Publishers MEI,2003 13. «Systems of automated control of electric drives»/ edited by Yu.N. Petrenko. М.: ACALEMA, 2005. 14. M.P. Belov, etc. «Automated electric drive of model production mechanisms and technological complexes», М.: ACALEMA, 2005. |