



Module Handbook

for the degree program

ELECTRICAL ENGINEERING

(Direction: Master's studies scientific and pedagogical)



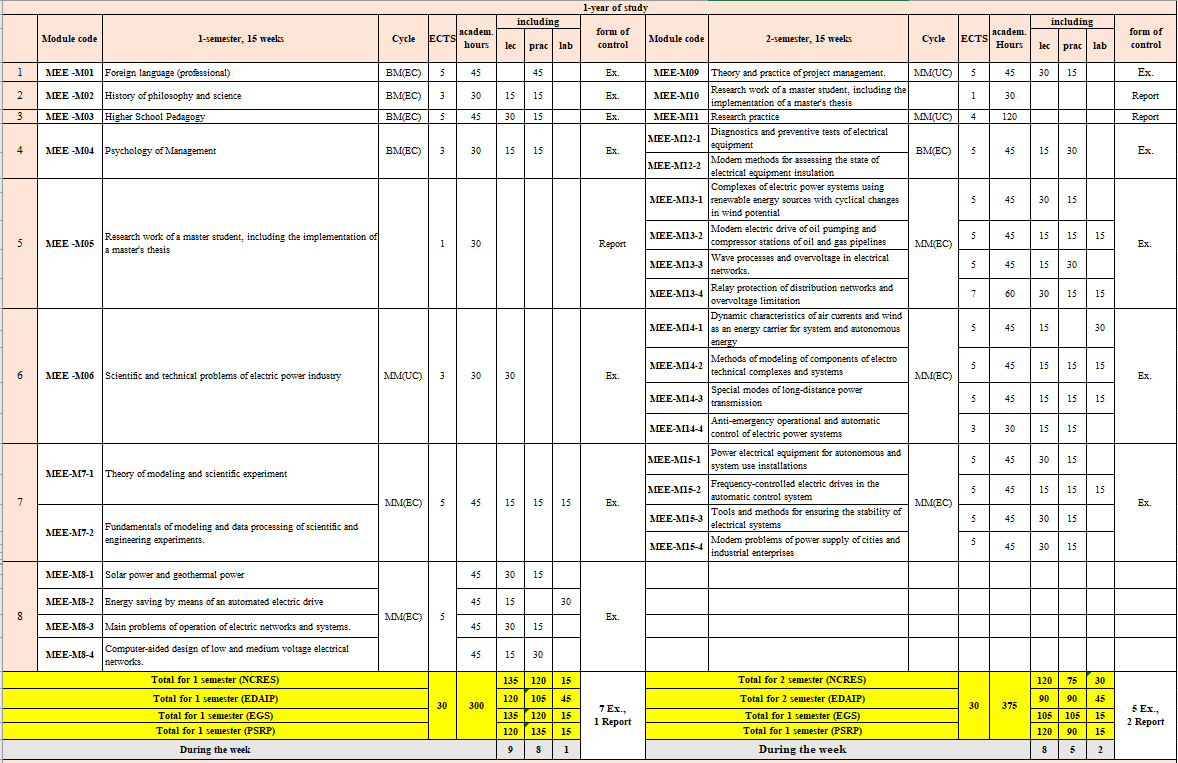
Almaty, 2020-2022

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Curriculum of postgraduate studies

7М07101 - Elecrtical engineering





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| **Module name** | **МEE-М01** **Foreign Language (Professional)** |
| **Semester(s), in which the module is taught** | 1 |
| **Person, responsible for the module** | PhD Akbota Zhussupova |
| **Language** | English |
| **Relation to curriculum** | **Compulsory** |
| **Teaching methods** | Practical classes, Master’s self-study work under a teacher’s supervision (MSWS) |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  practical classes -45; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Students are required to get a passing grade for “Foreign language 1, 2”. |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES:** The aim of the course is to develop basic communicative skills required for successful business operations, including searching, processing information in the English language. The course is mainly aimed at teaching practical English.  **LEARNING OUTCOMES:**  **Knowledge:**  - ethics of business communication;   * the language of actual science and engineering;   - appropriate and grammatically correct use of scientific and technical terminology in practical communication.  **Skills:**  - perform translation of technical and scientific texts;  - keep up conversation in Business English;  - perceive and process different types of information in the English language from various sources – printed materials, audio-visual and electronic sources, in professional (scientific and technical), social, political, and cultural fields of communication.  **Competences:**  - evaluating, analyzing and summarizing English texts related to professional spheres of communication;  - observing etiquette in oral and written communication; |
| **Content** | The contents of the course comply with the specific professional education of master’s degree students. General training and education components of the program are realized in parallel and in complex with the major specialization, so that language studies would favor acquisition of knowledge from a wide range of practical activities. |
| **Current control** | SSW 3, mid-term control 2, tests |
| **Final control** | Examination |
| **Study and examination requirents** | Personal computers, textbooks, audio-video aids. |
| **References** | 1. Loan Magretta. What Management is: How it Works and Why. // Free Press; Reissue edition. US, 2018, 256 p.  2. David Cotton. David Falvey. Simon Kent. Market Leader. Business English. Intermediate. – Pearson Education, 2008.  3. У.Б. Серикбаева. Английский язык. Учебное пособие для магистрантов  всех специальностей. 6М0719, 6МО717, 6МО718,  6МО702 – Алматы. АУЭС.2011. – 88 с.  4. А.Л.Луговая.Английский язык для студентов энергетических специальностей: учебное пособие. М., Высшая школа, 2017. -150 с.  5. Electric Circuit Problems for Energy Industry (electronic resource). <http://www.physicsclassroom.com/Class/circuits/u914c.cfm>  6. Коробейникова Л. Я. Английский язык. Методические указания по развитию умений написания эссе (для магистрантов всех специальностей), 2010.  7. Коробейникова Л. Я. Английский язык. Методические указания по развитию умений выступления с презентацией (для магистрантов всех специальностей), 2011.  8.Радовель В.А. Учебное пособие Английский язык для технических вузов. Москва. 2010  9. Murphy, Raymond. Essential Grammar in Use. A self study reference and practice book for elemePpress.2007.  10. Бухаров Г.П. Техническое чтение для энергетиков. Учебное пособие. Ульяновск. 2004.-112 с. |

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| **Module name** | **MEE-M02 "History and Philosophy of Science"** |
| **Semester(s) in which the module is taught** | 1 |
| **Person responsible for the module** | Professor Mukhamedzhan K. Sh. (Kaz)  associate professor Sharakpayeva G. D. (Rus) |
| **Language** | Kazakh/Russian/ English |
| **Relation to curriculum** | **Compulsory** |
| **Teaching methods** | lecture, seminar, Master’s self-study work under a teacher’s supervision (MSWS) |
| **Working hours (incl. class hours, self-study hours)** | **Total working hours:** 90 hours.  Class hours: lectures-15 hours; practical classes (seminars)- 15 hours; SSW-54 (MSWS - 5) hours.  **Examination preparation hours:** 6 |
| **Credits** | 3 |
| **Required and recommended prerequisites for joining the module** | Philosophy, Sociology, Culturology, Psychology cultural studies |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES:** development of scientific thinking style based on the history and philosophy of science study.  **LEARNING OUTCOMES:**  **Knowledge:**  of the nature, structure, principles of organization and functioning of science; the fundamental basis and conceptual apparatus of the history and philosophy science; relationship of scientific and philosophical thought; basic principles of research activities.  **Skills:** to develop cognitive and practical abilities.   * **Competences:** integrate knowledge, skills, social and methodological capabilities in work or study situations; to classify methods of scientific and philosophical world knowledge; to describe the main content of ontology and metaphysics in the context of the history and philosophy science. |
| **Content** | The module content consists of the main topics of philosophy science, the problems and results of the philosophy science, their significance for science and philosophy as a general methodology for undergraduate’s cognitive activity. Development patterns of scientific knowledge as a subject of history and philosophy science. Aspects of studying the history and philosophy of science: philosophy of science, science studies, sociology of science, psychology of science, ethics of science. Science as a knowledge system and as a social institution. Science as a form of social consciousness and productive force of society. Disputes about the place and role of science in culture: scientism and anti-scientism. Internalism and externalism are two competing concepts in the history of science: Alexander Koyre and John Desmond Bernal as examples of approaches implementation. Cumulative and anti-cumulative models of the scientific knowledge dynamics. |
| **Current control** | Term works 2, Midterm control 2, oral presentation, essay. |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, ethics in the classroom and during the exam |
| **References** | 1. История и философия науки: учебное пособие. Н.В. Бряник, О.Н. Томюк.- М.: Юрайт, Екатеринбург: Изд-во Уральского университета, 2020.  2. Розин В.М. История и философия науки. Учебное пособие для бакалавриата и магистратуры. – М.: Юрайт,2019.  3. Степин В.С. История и философия науки. – М.: Академический Проект, 2011. – 423 с.  4. Хасанов М.Ш., Петрова В.Ф. История и философия науки. – Алматы: Қазақ университеті, 2013. – 150 с.  5.Бучило Н.Ф., Исаев И.А. История и философия науки. – М.: «Проспект», 2012.  6. Мухамеджан К.Ш., Шаракпаева Г.Д., Шицко В.Л. История и философия науки. Конспект лекций для всех специальностей. – Алматы, 2010.  7.Шаракпаева Г.Д., Шицко В.Л. История и философия науки. Методические указания к семинарским занятиям для магистрантов всех специальностей. – Алматы, 2009.  8. Митрошенков О.А. История и философия науки. М.: Юрайт,2020.  9.Бакеева Е.В. Современная философия. Введение в онтологию: учебное пособие. М.: Юрайт,2020.  10. Кохановский В.П., Лешкевич Т.Г., Матяш Т.П., Фатхи Т.Б. «Философия науки» в вопросах и ответах. – Ростов – на – Дону, 2008.  11. Е.В. Ушаков. «Введение в философию и методологию науки». – М., 2008. 12. Кохановский В.П., Лешкевич Т.Г., Матяш Т.П., Фатхи Т.Б. «Основы философии науки». – Ростов – на – Дону, 2007. 13 Кохановский В.П., ЛешкевичТ.Г., Матяш Т.П., Фатхи Т.Б. «Философия науки» в вопросах и ответах. – Ростов – на – Дону, 2007.  14.Философия науки. Общий курс: учебное пособие. Под ред. С.А. Лебедева. 5-е изд. перераб. и дополненное. – М., 2007. |

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| **Module name** | **МEE-М03*****“*Higher School Pedagogy*”*** |
| **Semester(s), in which the module is taught** | 1 |
| **Person, responsible for the module** | Senior lecturer Ulmeken Toleshova |
| **Language** | Kazakh, Russian |
| **Relation to curriculum** | **Compulsory** |
| **Teaching methods** | lecture, practical seminars, Master’s self- study work under a teacher’s supervision (MSWS) |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; practical classes -30; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Module of socio-political knowledge (culturology and psychology) "Psychology and Pedagogy", "Organization Theory", "Fundamentals of Management", "Personnel Management", "Organizational Behavior” |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  the formation of pedagogical competence, the ability for pedagogical activity in universities based on the knowledge of didactics of higher education, the theory of education and management of education, analysis and self-assessment of teaching activities.  **LEARNING OUTCOMES:**  **Knowledge:** to know the basics of pedagogical activity in higher education; megatrends in the development of education and the Bologna process; various strategies and methods of teaching and education in higher education.  **Be able to** effectively apply modern didactic principles and technologies of analysis, planning and organization of training and education in professional and pedagogical activities.  **To develop** strategies for professional growth, introspection and gaining teaching experience at the higher education level.  **To demonstrate** the use of traditional and innovative methods and forms of organization of education, new educational technologies in higher education.  **To demonstrate** the ability to understand the essence of the pedagogical activity of a university teacher, current problems of the education system in general and pedagogical science in particular;  **Structuring** the content of higher professional education; assess students' competencies. |
| **Content** | The course is aimed at getting acquainted with the mega-trends in the development of education and the Bologna process, mastering lecturer, curatorial skills using various strategies and methods of teaching and education in higher education. |
| **Current control** | Presentation, Essay, mid-term control -2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software. |
| **References** | 1. Ахметова Т.К., Исаева З.А. Педагогика: Учебник для магистратуры университетов. - Алматы: Казак университеті, 2006. - 328 с. 2. Мынбаева А.К. Основы педагогики высшей школы: Учебное пособие. - Алматы, 2008. - 144 с. 3. Краевский В.В, Хуторской А.В. Основы обучения. Дидактика и методика. учеб. пособие для студ. высш. учеб. заведений / В. В. Краевский, А. В. Хуторской. — М.: Издательский центр «Академия», 2007 -352 с. 4. Таубаева Ш.Т. Введение в методологию и методику педагогического исследования. – Туркистан: Туран, 2007. – 190 с. 5. Мынбаева А.К., Садвакасова З.М. Инновационные методы обучения, или как интересно преподавать. – Алматы, 2012. – 233 с. 6. Блинов, В. И.  Методика преподавания в высшей школе: учебно-практическое пособие / В. И. Блинов, В. Г. Виненко, И. С. Сергеев. — Москва : Издательство Юрайт, 2018. — 315 с. |

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| **Module name** | **МEE-М04 “Psychology of Management”** |
| **Semester(s), in which the module is taught** | 1 |
| **Person, responsible for the module** | Senior lecturer Nazilya Ashirbaeva |
| **Language** | Kazakh, Russian |
| **Relation to curriculum** | **Compulsory** |
| **Teaching methods** | lecture, practical seminars, Master’s self-study work under a teacher’s supervision (MSWS) |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 90 hours  **Class hours:**  lectures -15; practical classes -15; SSW – 54 (MSWS-5)  **Examination preparation hours:** 6 |
| **Credits** | 3 |
| **Required and recommended pre-requisites for joining the module** | Module of socio-political knowledge (culturology and psychology) "Psychology and Pedagogy", "Organization Theory", "Fundamentals of Management", "Personnel Management", "Organizational Behavior” |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  teaching the basics of psychology in the management system, expanding professional opportunities in terms of applying psychological knowledge in the field of management.  **LEARNING OUTCOMES:**  **Knowledge:** to understand the socio-psychological nature of management activities; properties of psychological processes included in cognitive activity; the content and specifics of the psychological impact.  **Skills:** toform decisions on the effective application of modern methods and techniques of management psychology in the organization; on the use of the necessary psychological and methodological resources for management activities; on the use of adequate psycho-diagnostic methods for studying the individual and the group.  **Competences:** to have an experience in developing programs for resolving conflict situations in society, including in professional society; on the correct expression and reasoned upholding of one's own opinion on issues of social significance. |
| **Content** | The main methodological provisions of psychological science, its main laws, principles within the framework of learning processes, didactics, systemic, activity, technological and personality-oriented approaches as a methodology of psychology, as well as methods, problems and prospects for its development are outlined; |
| **Current control** | Presentation, Essay, mid-term control -2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software. |
| **References** | 1. Годфруа Ж. «Что такое психология». Том 1. – М.: Мир, 2005 – 496 с.  2. Годфруа Ж. «Что такое психология». Том 2. – М.: Мир, 2005 – 276 с.  3. Даниел Гоулман. «Эмоциональный интеллект. Почему он может значить больше, чем IQ». Изд-во Манн, Иванов и Фербер: 2018. -560 с.  4. Джакупов С.М. «Введение в общую психологию». – А.: Қазақ университеті, 2014  5. Ильин Е.П. «Психология общения и межличностных отношений». - СПб.: Питер, 2009. - 576 с. ил. - (Серия «Мастера психологии»).  6. Майерс Д. «Психология» / пер. с англ. И.А. Карпиков, В.А. Старовойтова. – 4-е изд. - Минск: «Попурри», 2009. – 848 с. |

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| **Module name** | **МEE-М05/10/17/23 *“*Research work of a master student*”*** |
| **Semester(s), in which the module is taught** | 1, 2, 3, 4 |
| **Person, responsible for the module** | R.M. Nigmatullin, Cand. of Tech. Sc., Associate Professor |
| **Language** | Kazakh, Russian |
| **Relation to curriculum** | **Compulsory** |
| **Teaching methods** | Master’s self- study work under a teacher’s supervision (MSWS) |
| **Working hours (including class hours, self-study hours)** | 30 hours (Semester 1); 30 hours (Semester 2); 330 hours (Semester 3); 330 hours (Semester 4); |
| **Credits** | 1 credit (Semester 1); 1 credit (Semester 2); 11 credits (Semester 3);  11 credits (Semester 4); |
| **Required and recommended pre-requisites for joining the module** | Scientific and Technical Problems of Electric Power Systems, Research Methods and Experimental Organisation. |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVE:**  to set, discuss and refine the scientific research problem; to search and study the scientific literature on methods of solving the problem with a bibliography; to make an analytical overview of known research methods; to master computer programmes widely used in the electricity sector.  **LEARNING OUTCOMES:**  **Demonstrate** the ability to improve and develop his/her intellectual level on the basis of knowledge of philosophy of science, pedagogy of higher education, foreign languages and management psychology. Is able to independently acquire new knowledge and skills and expand his/her scientific outlook.  **Ability to** use effectively modern computer and information technologies, digital techniques and software in solving scientific and technical tasks of power engineering. Master the skills of working with computer programmes Rastr Win, PS CAD, Dig Silent Power Factory, and MatLab.  **To master** the knowledge of scientific management of energy enterprises, the ability to carry out technical and economic analysis of the efficiency of design solutions, the skills of working with automatic design systems and the use of applications in scientific and engineering design calculations. |
| **Content** | The course is aimed at getting acquainted with the mega-trends in the development of education and the Bologna process, mastering lecturer, curatorial skills using various strategies and methods of teaching and education in higher education. |
| **Current control** | Supervision of research tasks is carried out by the university supervisor |
| **Final control** | Defend the report on the research work of a Master's student during the attestation period. |
| **Training and examination requirements** | Study of normative documents; laboratory equipment of the laboratories of the Department of EPS, ESRES and EMED; preparation of a presentation for the defence of the research work report. |
| **References** | 1. Нормативные документы по высшему и послевузовскому образованию.  2. Хан С.Г. Методические указания по организации и проведению профессиональной практики по группе образовательных программ послевузовского образования «Автоматизация и управление» для магистрантов ОП «Автоматизация и управление». – Алматы: АУЭС, 2020. – с. 20. |

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| **Module name** | **МEE-М06 *“*Scientific and technical problems of electric power industry*”*** |
| **Semester(s), in which the module is taught** | 1 |
| **Person, responsible for the module** | Associate Professor R. M. Nigmatullin |
| **Language** | Kazakh, Russian |
| **Relation to curriculum** | **Compulsory** |
| **Teaching methods** | lecture, Master’s self- study work under a teacher’s supervision (MSWS) |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 90 hours  **Class hours:**  lectures -30; SSW – 54 (MSWS-5)  **Examination preparation hours:** 6 |
| **Credits** | 3 |
| **Required and recommended pre-requisites for joining the module** | Disciplines studied in the course of undergraduate studies in the educational program - Electrical Engineering. Direction: 5В071800 - "Engineering" |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  Examine the problems associated with the growing demand for electricity and the depletion of fuel for conventional power plants. A look at decarbonisation issues and international experience in solving them. An overview of the main causes of problems in the electricity sector, their impact on the environment and the economy, identifying possible solutions in practice.  **LEARNING OUTCOMES:**  Master's students know:  - about modern technologies of power generation and transmission, complex solutions of scientific and technical problems faced by the power industry;  - The main ways to optimise the operation modes of power plants;  - Performance characteristics of power equipment of the plants.  know how to:  - identify sources and search for information needed to improve operations.  - analyse the state and problems of the electric power industry;  - analyse features of power equipment operation modes;  - analyse modern problems of electric power industry and find a comprehensive approach to their solution.  **COMPETENCIES:**  - Apply knowledge, understanding and ability to solve problems in new or unfamiliar situations.  - Apply in practice and be guided by normative documents when dealing with technical issues of production;  - organise and carry out the maintenance of complex power installations, measuring and monitoring of operating modes.  - To be competent in carrying out scientific projects and research in the professional field. |
| **Content** | Explore electricity generation technologies and explore the problems associated with the increasing demand for electricity and the depletion of fuel for conventional power plants. To consider the current ways of solving the problems encountered in the electricity sector and to learn from international experience in solving them. An overview of the main causes of electricity problems, their impact on the environment and the economy, identifying possible solutions in practice. |
| **Current control** | Presentation, Essay, mid-term control -2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software. |
| **References** | 1. Сибикин Ю.Д. Альтернативные источники энергии.- М.: «Радио Софт», 2014.  2. Сабден О. Энерго-экологическая безопасность Казахстана и новые возможности комплексного использования углеводородных ресурсов. - Алматы , 2011.  3. Алхосов А.Б. Возобновляемые источники энергии. - М: «МЭИ», 2011.  4. Виссарионов В.И. Солнечная энергетика. - М.: «МЭИ», 2011.  5. Болотов А.В. Научно-технические проблемы электроэнергетики. Конспект лекций. - А.: «АУЭС», 2010.  6. Болотов А.В. Современные проблемы электроэнергетики. Конспект лекций. - А.: «АУЭС», 2010.  7. Болотов А.В. Современные проблемы электроэнергетики. Методические указания и задания к расчетно-графической работе №1 для магистрантов энергетического факультета специальности 6М071800 «Электроэнергетика» профильная магистратура. – А.: «АУЭС», 2011.  8.Матвеев В. Возобновляемые источники энергии. Энергия-солнца, биомассы, ветра, воды. Энергетические технологии и установки. - А.: «Бастау»,2009.  9. Виссарионов В.И. Методы расчета ресурсов возобновляемых источников энергии. -М.: «МЭИ». 2009  Н. Искаков. Возобновляемые источники энергии и энергосбережение. Астана, 2008.  10.Тенденции развития мировой и российской энергетики. [www.elek.ru/](http://www.elek.ru/)  11.Развитие альтернативной энергетики в Казахстане [www.zakon.kz/](http://www.zakon.kz/) |

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| **Module name** | **МEE-М7-1 “Theory of modeling and scientific experiment”** |
| **Semester(s), in which the module is taught** | 1 |
| **Person, responsible for the module** | Associate Professor R. M. Nigmatullin (kaz)  Professor Omarov R. A. (Russian) |
| **Language** | Kazakh, Russian |
| **Relation to curriculum** | **Variation** with " Fundamentals of modeling and data processing of scientific and engineering experiments" |
| **Teaching methods** | lecture, practical seminars, Master’s self- study work under a teacher’s supervision (MSWS) |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; laboratory work-15; practical classes -15; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Disciplines studied during the Bachelor's study programme – Electrical engineering, direction: 5B071800 - Engineerin, Mathematical Theory of Experiment Planning, Theoretical Foundations of Electrical Engineering. |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  To develop knowledge on modelling theory and features of regression models of power systems, to study the theory of experiment planning and features of passive and active experimentation.  **LEARNING OUTCOMES:**  **Master's students know:**  - theoretical provisions of modelling a scientific experiment;  - methods of mathematical processing of experimental data;  - Statistical and regression analysis software in MATLAB;  - interpolation methods;  - Interpolation software of functions in MATLAB system;  are able to:  - Solve algebraic, transcendental and differential equations;  - solve problems in statistics and regression analysis in MATLAB system;  - use MATLAB software system;  - analyze the results of the experiment;  **COMPETENCIES:**  - Apply knowledge, understanding and problem solving in the research and modelling of RES and transient processes in power grids.  - Apply SimPowerSystems and Simulink applications in the simulation of transient processes in electrical networks to solve technical production issues;  - organise and carry out technical upgrades and maintenance of complex power installations and measuring and control equipment.  - To be competent in carrying out scientific projects and research, to plan and carry out scientific experiments independently. |
| **Content** | A number of issues related to computer modelling of electro-physical processes in energy networks and systems are studied. The basis for classical algorithms of processing arrays of numerical data of experiments, were the sciences: mathematical statistics, probability theory. The tasks of modern programming of models imitating reliable in-situ experiments, research of scientific, technical problems in the field of power engineering. |
| **Current control** | Essay, mid-term control -2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software. |
| **References** | 1. Асатурян В. И. Теория планирования эксперимента. – М.: Радио и связь, 1983.  2. Адлер Ю.П., Маркова Е. В., Грановский Ю. В. Планирование эксперимента при поиске оптимальных условий. – М.: Наука, 1971.  3. Мещеряков В. В. Задачи по статистике и регрессивному анализу с MATLAB. – М.: ДИАЛОГМИФИ, 2009.  4. Ануфриев И. Е., Смирнов А. Б., Смирнова Е.Н. MATLAB 7. – СПб.: БХВ Петербург, 2005.  5. Черных И. В. Моделирование электротехнических устройств в MATLAB, SimPowerSystems и Simulink. - М.: ДМК Пресс; СПб.: Питер, 2008.  6. Герман-Галкин С. Г. Компьютерное моделирование полупроводниковых систем в Matlab 6.0: Учебное пособие. — СПб.: КОРОНА 2001  7. Монография А. Ф. Дащенко, В. Х. Кириллов, Л. В. Коломиец, В. Ф. Оробей МАТЛАБ в инженерных и научных и расчетах. Одесса «Астропринт» 2003  8. Дьяконов В. П., MATLAB и Simulink в электроэнергетике: справочник / Дьяконов В.П., Simulink 5/6/7: самоучитель - М.: ДМК Пресс, 2008.  9. Черных И. В. SIMULINK: среда создания инженерных приложений / Под общей редакцией к. т. н. В. Г. Потемкина. - М.: ДИАЛОГ-МИФИ, 2003.  10. Дьяконов В. П. MATLAB. Учебный курс. — СПб.: ПИТЕР. - 2001.  11. Дьяконов В. П. Simulink 4. Специальный справочник. — СПб.: ПИТЕР, 2002. |

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| **Module name** | **МEE-М7-2 “Fundamentals of modeling and data processing of scientific and engineering experiments”** |
| **Semester(s), in which the module is taught** | 1 |
| **Person, responsible for the module** | Associate Professor R. M. Nigmatullin |
| **Language** | Kazakh, Russian |
| **Relation to curriculum** | **Variation** with "Theory of modeling and scientific experiment " |
| **Teaching methods** | lecture, practical seminars, Master’s self- study work under a teacher’s supervision (MSWS) |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; laboratory work-15; practical classes -15; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Disciplines studied during the Bachelor's study programme – Electrical engineering, direction: 5B071800 - Engineerin, Mathematical Theory of Experiment Planning, Theoretical Foundations of Electrical Engineering. |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  Studying the basics of modelling and data processing of scientific and engineering experiments, methods of planning and carrying out multifactorial experiments in power grids, mastering methods of processing experimental results.  **LEARNING OUTCOMES:**  **Master's students know:**  **-** Fundamentals of modelling and data processing of scientific and engineering experiments;  - Methods of mathematical processing of experimental data;  - Software for interpolation of functions in MATLAB system;  know how to:  - Solve algebraic, transcendental and differential equations;  - solve problems in statistics and regression analysis in MATLAB system;  - use MATLAB software system;  - analyze the results of the experiment;  **COMPETENCIES:**  - To apply in practice modern software products for simulation of engineering experiments, data processing of scientific and engineering experiment, to carry out studies of transient processes in electrical networks and systems.  - Apply SimPowerSystems and Simulink applications in simulation of transient processes in electrical networks in solving technical issues and writing master theses;  - independently plan, conduct and process the data of scientific experiments. |
| **Content** | A number of issues relating to the mathematical processing of arrays of numbers from a series of experiments are explored. Planning techniques for conducting multi-factor experiments in the field of power engineering. Basic laws of Probability Theory and Mathematical Statistics. Modern software products for simulation engineering experiments, models and studies of transient physical processes in electrical grids and systems. |
| **Current control** | Essay, mid-term control -2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software. |
| **References** | 1. Черных И. В. SIMULINK: среда создания инженерных приложений / Под общей редакцией к. т. н. В. Г. Потемкина. - М.: ДИАЛОГ-МИФИ, 2003.  2. Дьяконов В.П., Matlab 6.5 Spl/7+Simulink 5/6. Обработка сигналов и проектирование фильтров. М.: Солон-Пресс, 2005.  3. Герман-Галкин С. Г. Компьютерное моделирование полупроводниковых систем в Matlab 6.0: Учебное пособие. — СПб.: КОРОНА 2001  4. Система Power System Blockset. Руководства пользователя". Перевод с англ. Гнедина П. 2001  5. Мещеряков В. В. Задачи по статистике и регрессивному анализу с MATLAB. – М.: ДИАЛОГМИФИ, 2009.  6. Ануфриев И. Е, Смирнов А. Б., Смирнова Е. Н. MATLAB 7. – СПб.: БХВ Петербург, 2005.  7. Черных И. В. Моделирование электротехнических устройств в MATLAB, SimPowerSystems и Simulink. - М.: ДМК Пресс; СПб.: Питер, 2008.  8. Монография А. Ф. Дащенко, В. Х. Кириллов, Л. В. Коломиец, В. Ф. Оробей МАТЛАБ в инженерных и научных и расчетах. Одесса «Астропринт» 2003  9. Дьяконов В. П., MATLAB и Simulink в электроэнергетике: справочник / Дьяконов В.П., Simulink 5/6/7: самоучитель - М.: ДМК Пресс, 2008.  10. Черных И. В. SIMULINK: среда создания инженерных приложений / Под общей редакцией к. т. н. В. Г. Потемкина. - М.: ДИАЛОГ-МИФИ, 2003.  11. Дьяконов В. П. MATLAB. Учебный курс. — СПб.: ПИТЕР. - 2001. |

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| **Module name** | **MEE-M12-1 “Diagnostics and profiling tests of electrical equipment”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | PhD Amitov Yer.T. |
| **Language** | Russian |
| **Relation to curriculum** | **Variative** with **“**Modern methods of assessing the state of insulation of electrical equipment” |
| **Teaching methods** | Lectures, practical seminars, calculation-graphical works, individual work of a master student under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  Lectures - 15; practical classes - 30; SSW - 99(MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Scientific and technical problems of the electric power industry. Basic problems of operation of electric grids and systems. |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  mastery of knowledge of modern diagnostics and methods of preventive testing of high-voltage electrical equipment, ensuring their reliable operation.  **LEARNING OUTCOMES:**  Master's students will know:  - modern diagnostic methods and methods of preventive testing of high-voltage electrical equipment;  - identification of dangerous changes before the occurrence of insulation damage;  - systems of in-service insulation control;  - measurement of dielectric loss angle and capacitance.  know how to:  - measure insulation resistance using megohmmeter and other devices;  - control the operation of electrical equipment with and without shutdown;  - measure dielectric loss angle and capacitance;  - test electrical equipment with normal and lightweight insulation with industrial frequency voltage.  **COMPETENCIES:**  **-** Knows and can apply in practice modern methods and means of diagnostics and preventive testing of high voltage electrical equipment;  - is able to independently carry out diagnostics of electrical equipment and set the terms of current and overhaul repairs;  - analyse and critically assess the remaining service life of high-voltage electrical equipment. |
| **Content** | Diagnostics of the condition of insulation of electrical equipment. The main indicators of the quality of insulation and the factors affecting changes in their characteristics. Thermal, mechanical and electrical loads acting on the insulation of electrical equipment. Reliability of electrical insulation materials. Methods of preventive testing. Evaluation of the condition of insulation of electrical machines and power transformers. Testing of insulation with high voltage. |
| **Current control** | Graphic design work-3, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, lab facilities. |
| **References** | 1. Ю.Г. Черемисинов Диагностика и профиспытания оборудования электрических станций и подстанций. Учебное пособие для магистрантов специальности бМ071800 – Электроэнергетика, АУЭС, 2017;  2. Техника высоких напряжений. Под общей редакцией д.т.н., проф. Кучинского Г.С. С – Петербург, Энергоатомиздат, 2003 г., 606 с.  3. Искаков А.К. Оспонов Б.К. Диагностика и непрерывный контроль эксплуатируемых объектов энергетики- Томск, 2006 г.,370 с.  4. Кудрин Б.И. и др. Электрооборудование промышленности.-М.,2008.  5. Михеев Г.М. Электростанции и электрические сети. Диагностика и контроль электрооборудования.-М.: «Додэка», 2010.  6. Верещагин И.П. Электрофизические основы техники высоких напряжений.-М. «МЭИ», 2010  7. Михеев Г.М. Цифровая диагностика высоковольтного электрооборудования.-М., 2008  8. Бекмагамбетова К.Х., Борисов В.Н., Оржанова Ж.К. Диагностика и профилактические испытания изоляции электрооборудования. Методические указания и задания к РГР.– Алматы: АИЭС, 2009 г. |

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| **Module name** | **MEE-M12-2 “Modern methods of assessing the state of insulation of electrical equipment”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | PhD Amitov Yer. T. |
| **Language** | Russian |
| **Relation to curriculum** | **Variative** with“Diagnostics and profiling tests of electrical equipment” |
| **Teaching methods** | Lectures, practical seminars, calculation-graphical works, independent work of the master under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  Lectures - 15; practical classes - 30; SSW - 99(MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Scientific and technical problems of the electric power industry. Basic problems of operation of electric grids and systems. |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  to form the knowledge system of master's students on methods and means of assessment and control of the technical condition of the insulation of high-voltage equipment.  **LEARNING OUTCOMES:**  Master's students know:  - Methods and technical means of diagnostics of HV equipment insulation;  - methods of analysis of diagnostic parameters;  - rules and procedures for preventive testing of insulation of high-voltage equipment;  know how to:  - analyze and predict the wear and aging of the insulation of electrical equipment;  - assess the condition of insulation of high-voltage equipment with and without disconnection from the network;  - process the results of insulation testing of electrical equipment.  **COMPETENCIES:**  - Are able to analyze the condition of the insulation of high voltage electrical equipment using modern methods and means;  - possess the methodology of theoretical and experimental studies of insulation control of electrical equipment with and without disconnection from the mains;  - can independently operate test facilities for controlling the insulation of high-voltage equipment. |
| **Content** | Wear and aging of insulation of electrical equipment. Effect of insulation wetting on the aging process and on electrical resistance. Dependence of insulation resistance of electrical machines on temperature. Assessment of insulation condition of power transformers based on the results of gas-chromatographic analysis of oil samples. Acoustic method of quality control of insulators. Inspection methods without disconnecting electrical equipment. Visual tools for determining defects Testing installations of high AC and DC voltage to control insulation. |
| **Current control** | Graphic calculations-3, final inspection 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, lab facilities. |
| **References** | 1. Ю.Г. Черемисинов Диагностика и профиспытания оборудования электрических станций и подстанций. Учебное пособие для магистрантов специальности бМ071800 – Электроэнергетика, АУЭС, 2017  2. Техника высоких напряжений. Под общей редакцией д.т.н., проф. Кучинского Г.С. С – Петербург, Энергоатомиздат, 2003 г., 606 с.  3. Искаков А.К. Оспонов Б.К. Диагностика и непрерывный контроль эксплуатируемых объектов энергетики- Томск, 2006 г.,370 с.  4. Кудрин Б.И. и др. Электрооборудование промышленности.-М.,2008.  5. Михеев Г.М. Электростанции и электрические сети. Диагностика и контроль электрооборудования.-М.: «Додэка»,2010.  6. Верещагин И.П. Электрофизические основы техники высоких напряжений.-М. «МЭИ»,2010  7. Михеев Г.М. Цифровая диагностика высоковольтного электрооборудования.-М.,2008  8. Бекмагамбетова К.Х., Борисов В.Н. , Оржанова Ж.К. Диагностика и профилактические испытания изоляции электрооборудования. Методические указания и задания к РГР.– Алматы: АИЭС, 2009 г. |

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| **Module name** | **MEE-M18-1 “Electricity quality and energy saving in the power industry”** |
| **Semester(s), in which the module is taught** | 3 |
| **Person, responsible for the module** | Professor G. G. Trofimov |
| **Language** | Russian |
| **Relation to curriculum** | **Variative** with **“**General quality management: a general approach, and specific application in the field of energy” |
| **Teaching methods** | Lectures, practical seminars, laboratory works, individual work of master students under the guidance of teacher. |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 120 hours  **Class hours:**  Lectures -15; practice -15; SSW - 84; MSWS – 6  **Examination preparation hours:** 6 |
| **Credits** | 4 |
| **Required and recommended pre-requisites for joining the module** | "Higher Mathematics", "Theoretical Foundations of Electrical Engineering", "Theory of Simulation and Scientific Experiment". |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  study of power quality indicators, basic principles, ways and means to ensure their normalized performance  **LEARNING OUTCOMES:**  Bachelors know:  - the entire list of tasks related to providing consumers with electricity at normalized quality;  - ways of voltage regulation to improve the quality of electricity;  - various aspects of electromagnetic compatibility;  - the main directions of reducing power losses in power grids in the design and operation;  - principles of power rationing.  know how to:  - calculate various voltage quality indicators;  - how to measure voltage quality indexes;  - evaluate the impact of individual quality indicators on the performance of power supply systems;  - apply technical means of power quality normalization in power supply systems.  COMPETENCIES:  - Apply regulatory documents in practice and be guided by them in solving technical issues of production;  - organize and perform maintenance of power supply systems. |
| **Content** | Formation of sustainable knowledge on the issues of energy saving and rational design and operation of power supply systems, quality of power supply. Basic power quality indicators and their permissible values. Controlling the quality of electricity. Influence of electric power quality on electromagnetic compatibility. Statistical evaluation of electric power quality indicators. Methods and means of improving the quality of voltage in industrial power grids. |
| **Current control** | Examinations and graphical works 1, examinations test 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, lab facilities. |
| **References** | 1. Кобозев В.А., Лыгиин И.В.: Качество электроэнергии и энергоэффективность систем электроснабжения потребителей. Учебное пособие, Издательство: [Инфра-Инженерия](https://www.labirint.ru/pubhouse/2357/), 2022 г,   <https://www.labirint.ru/books/810929/>  2. Волков Н.Г., Качество электроэнергии в системах электроснабжения, учебное пособие, Изд-во Томского политехнического университета, 2010. – 152  3. Л.И. Коверникова, В.В. Суднова, Р.Г. Шамонов и др., Качество электрической энергии: современное состояние, проблемы и предложения по их решению /; отв. ред. Н.И. Воропай. – Новосибирск: Наука, 2017. – 219 с., <https://isem.irk.ru/upload/iblock/b2c/b2c78d180c2fe6ca58d988782885da5b.pdf>  4. Жежеленко И.В., Саенко Ю.Л. Показатели качества электроэнергии и их контроль на промышленных предприятиях, М.: Энергоатомиздат, 2000. - 252 с. , <https://www.twirpx.com/file/148252/>  5. Висящев А.Н., Качество электрической энергии и электромагнитная совместимость в электроэнергетических системах: Учебное пособие.– Иркутск, 1997. – Ч. 1., <https://www.twirpx.com/file/35457> |

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| **Module name** | **MEE-M18-2 “General quality management: a general approach, and specific application in the field of energy”** |
| **Semester(s), in which the module is taught** | 3 |
| **Person, responsible for the module** | Professor G. G. Trofimov |
| **Language** | Russian |
| **Relation to curriculum** | **Variative** with“Electricity quality and energy saving in the power industry” |
| **Teaching methods** | lectures, practical seminars,  Independent work of students under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 120 hours  **Class hours:**  Lectures -15; practice -15; SSW - 84; MSWS-6  **Examination preparation hours:** 6 |
| **Credits** | 4 |
| **Required and recommended pre-requisites for joining the module** | "Higher Mathematics", "Theoretical Foundations of Electrical Engineering", "Theory of Simulation and Scientific Experiment". |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  mastering the basic knowledge of the principles, methods and technical means of quality management of electrical energy, power quality rationing and reduction of power losses  **LEARNING OUTCOMES:**  Bachelors know:  - the entire list of tasks associated with managing the quality of electrical energy in its consumption;  - ways of voltage regulation for power quality management in power system and power supply systems;  - various aspects of electromagnetic compatibility;  - main directions of reducing electric power losses in power grids during design and operation;  - principles of power consumption control.  know how to:  - calculate and manage various voltage quality indicators;  - how to measure voltage quality indexes;  - evaluate the impact of individual quality indicators on the performance of the power supply system;  - apply technical means to control the quality of electricity in power supply systems.  **COMPETENCIES:**  - Apply regulatory documents in practice and be guided by them in solving technical issues of production;  - organize and perform maintenance of power supply systems. |
| **Content** | Master the basic information about the principles, methods and technical means to manage the process of rational use of electricity and reduce energy losses in the power supply system of the industrial enterprise, as well as the provision of consumers with electricity at normalized quality, reliability and efficiency. The main ways and methods of managing the quality of electrical energy, reliability and efficiency, as well as the main ways of energy saving are considered. |
| **Current control** | Calculated graphic work 1, end-of-term control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, lab facilities. |
| **References** | 1. Кобозев В.А., Лыгиин И.В.: Качество электроэнергии и энергоэффективность систем электроснабжения потребителей. Учебное пособие, Издательство: [Инфра-Инженерия](https://www.labirint.ru/pubhouse/2357/), 2022 г, <https://www.labirint.ru/books/810929/> 2. Волков Н.Г., Качество электроэнергии в системах электроснабжения, учебное пособие, Изд-во Томского политехнического университета, 2010. - 152 3. Л.И. Коверникова, В.В. Суднова, Р.Г. Шамонов и др., Качество электрической энергии: современное состояние, проблемы и предложения по их решению /; отв. ред. Н.И. Воропай. – Новосибирск: Наука, 2017. – 219 с., <https://isem.irk.ru/upload/iblock/b2c/b2c78d180c2fe6ca58d988782885da5b.pdf> 4. Жежеленко И.В., Саенко Ю.Л. Показатели качества электроэнергии и их контроль на промышленных предприятиях, М.: Энергоатомиздат, 2000. - 252 с. , <https://www.twirpx.com/file/148252/> 5. Висящев А.Н., Качество электрической энергии и электромагнитная совместимость в электроэнергетических системах: Учебное пособие.– Иркутск, 1997. – Ч. 1., <https://www.twirpx.com/file/35457> |

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| **Module name** | **MEE-M19-1 “Electromagnetic compatibility in the electric power industry”** |
| **Semester(s), in which the module is taught** | 3 |
| **Person, responsible for the module** | Associate Professor, Candidate of Technical Sciences Gali Kakimzhan Oralovich |
| **Language** | Russian |
| **Relation to curriculum** | **Variative** with“Influence of strong external electromagnetic fields on the operation modes of secondary circuits of substations” |
| **Teaching methods** | Lectures, practical works, laboratory works, calculation-graphic works, individual work of graduate under the guidance of teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 90 hours  **Class hours:**  Lectures - 15; practical work - 15; SSW - 54 (MSWS -5)  **Examination preparation hours:** 6 |
| **Credits** | 3 |
| **Required and recommended pre-requisites for joining the module** | "Scientific and technical problems of power engineering". |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  mastering of knowledge in the field of electromagnetic compatibility at power engineering objects, rationing and reduction of electromagnetic interference.  **LEARNING OUTCOMES:**  Master's students will know:  - main types and sources of electromagnetic interference;  - consequences of the effect of electromagnetic fields;  - basic types of interference suppression devices and their characteristics;  - calculation methods of interference levels and electromagnetic field strengths;  - requirements to electromagnetic compatibility of technical means;  - means of protecting personnel from electromagnetic interference and electromagnetic fields.  know how to:  - identify sources of electromagnetic interference;  - determine the levels of interference, intensity of electromagnetic fields;  - determine the type and characteristics of interference suppression devices;  - select the type and parameters of lightning protection device.  **COMPETENCIES:**  - Is able to identify sources of electromagnetic interference and explain the mechanisms of their occurrence;  - assess the electromagnetic situation at electric power facilities;  - determine the parameters of technical condition of measuring equipment;  - analyze quality indicators of substation equipment operation |
| **Content** | The course contains general concepts of electromagnetic compatibility of technical means, regulatory documents on the definition of quality indicators of electrical energy, the identification of sources of electromagnetic fields, methods and techniques for determining the level of interference, the strength of electromagnetic fields, methods of protection against external magnetic fields, the rules for determining the type and characteristics. interference suppression devices, assess the electromagnetic situation at industrial facilities. |
| **Current control** | Semester tasks 3, midterm check 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, laboratory facilities. |
| **References** | 1 ЭМС и информационная безопасность в системах телекоммуникаций. Кечиев Л.Н., Степанов П.В. М.: Технологии 2014.  2 Электромагнитная совместимость и молниезащита в электроэнергетике. Дьякова А.Ф. М.: Горячая линия-Телеком 2009г.  3 Электромагнитная совместимость и молниезащита в электроэнергетике. Дьякова А.Ф., Максимов Б.К., Барисов Р.К. М.: Горячая линия-Телеком 2011г.  4 Управление качеством электроэнергии. Ю.В. Шарова. М.: МЭИ 2006 г.  5 Управление качеством электроэнергии. Учебное пособие. Карташев И.И., Тульский В.Н., Ю.В. Шарова. М.: МЭИ 2008г.  6 Сагитов П.И., Жумагулов К.К., Тойгожинова Ж.Ж. Электрические машины переменного тока. Учебное пособие. АУЭС, 2012.-85 с.  7 Сборник задач по электрическим машинам. Под ред. Кацман С.С. - М.: Академия, 2008г. – 320 с., ил.  8 Электрические машины. Лабораторные работы на ПК. Под ред. Герман-Галкин С.Г. СРБ.: Корона принт – 2010. |

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| **Module name** | **MEE-M19-2 “Influence of strong external electromagnetic fields on the modes of operation of the secondary circuits of substations”** |
| **Semester(s), in which the module is taught** | 3 |
| **Person, responsible for the module** | Associate Professor, Cand. Tech. Sci. Gali K. O. |
| **Language** | Russian |
| **Relation to curriculum** | **Variative** with“Electromagnetic compatibility in the electric power industry” |
| **Teaching methods** | Lectures, practical works, laboratory works, calculation-graphic works, individual work of graduate under the guidance of teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 90 hours  **Class hours:**  Lectures - 15; practical work - 15; SSW - 54 (MSWS -5)  **Examination preparation hours:** 6 |
| **Credits** | 3 |
| **Required and recommended pre-requisites for joining the module** | "Scientific and technical problems of power engineering". |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  Formation of knowledge in determining the sources of electromagnetic fields, electromagnetic situation in electrical substations and substantiation of ways to normalize and reduce electromagnetic interference.  **LEARNING OUTCOMES:**  Masters know:  - requirements for electromagnetic compatibility of technical means used in substations;  - main types and sources of electromagnetic interference;  - main types of interference suppressors for electric substations and their characteristics;  - methods for calculating the characteristics of interference suppression devices;  - methods for calculating interference levels, electromagnetic field strengths at electrical substations;  know how to:  - identify the sources of electromagnetic interference;  - determine the levels of interference, electromagnetic field strengths;  - determine the type and characteristics of interference suppression devices used;  - select the type and parameters of protective devices in the substation.  **COMPETENCIES:**  - application of basic regulatory and legal documents for determining electric power quality indicators, for permissible levels of electromagnetic field strengths;  - processing and analysis of the results of measurements of quality parameters of electric power;  - registration of protocols for measurement of quality parameters of electric power;  - estimation of parameters of technical condition of secondary circuits of substations. |
| **Content** | The course deals with the sources of electromagnetic fields, methods and ways of assessing the electromagnetic situation at electrical substations, measures to standardize and reduce electromagnetic interference, the regulatory documents on the definition of quality indicators of electrical energy, the general issues of electromagnetic compatibility, secondary circuits of substations and methods of their protection from the influence of external magnetic fields. |
| **Current control** | Semester tasks 3, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, lab facilities. |
| **References** | 1 ЭМС и информационная безопасность в системах телекоммуникаций. Кечиев Л.Н., Степанов П.В. М.: Технологии 2014.  2 Электромагнитная совместимость и молниезащита в электроэнергетике. Дьякова А.Ф. М.: Горячая линия-Телеком 2009г.  3 Электромагнитная совместимость и молниезащита в электроэнергетике. Дьякова А.Ф., Максимов Б.К., Барисов Р.К. М.: Горячая линия-Телеком 2011г.  4 Управление качеством электроэнергии. Ю.В. Шарова. М.: МЭИ 2006 г.  5 Управление качеством электроэнергии. Учебное пособие. Карташев И.И., Тульский В.Н., Ю.В. Шарова. М.: МЭИ 2008г.  6 Электрические машины переменного тока. Учебное пособие. АУЭС. Авторы Сагитов П.И., Жумагулов К.К., Тойгожинова Ж.Ж. 2012.-85 с.  7 Сборник задач по электрическим машинам. Под ред. Кацман С.С. - М.: Академия, 2008г. – 320 с., ил.  8 Электрические машины. Лабораторные работы на ПК. Под ред. Герман-Галкин С.Г. СРБ.: Корона принт – 2010. |

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| **Module name** | **MEE-M20-1 “Methods of analysis and evaluation of reliability in the electric power industry”** |
| **Semester(s), in which the module is taught** | 3 |
| **Person, responsible for the module** | Professor G.G. Trofimov |
| **Language** | Russian |
| **Relation to curriculum** | **Variative** with “Optimization and reliability in the power industry” |
| **Teaching methods** | lectures, practical seminars, individual work of master students under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 90 hours  **Class hours:**  Lectures - 15; practice - 15; SSW - 54; MSWS – 5  **Examination preparation hours:** 6 |
| **Credits** | 3 |
| **Required and recommended pre-requisites for joining the module** | "Higher Mathematics, "Theoretical Foundations of Electrical Engineering", "Theory of modeling and scientific experiment". |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  to master the knowledge of analysis and evaluation of the reliability indicators of power supply systems and electrical equipment and ways to improve the reliability of their work.  **LEARNING OUTCOMES:**  Bachelors know:  - nature and causes of failures of electric power industry facilities;  - basics of the mathematical theory of reliability, mathematical models for assessing reliability in the electric power industry (structural diagrams, graphs of possible states), reliability indicators used in the power industry and the main methods of processing the results of reliability research;  - peculiarities of technical and economic calculations in power supply systems with regard to reliability;  - basic issues of organization and planning of reliability studies.  know how to:  - analyze and apply the provisions of probability theory and mathematical statistics to determine power supply reliability indicators, calculate the reliability of power supply systems, and analyze the reliability of individual power supply systems;  - calculate the reliability of objects at various schemes of redundancy and forecast the state of electrical equipment, electrical facilities and power supply systems from the position of reliability.  **COMPETENCIES:**  - Apply regulatory documents in practice and be guided by them in solving technical issues of production;  - Organize and perform maintenance of power supply systems with an appropriate degree of reliability. |
| **Content** | Mastering the knowledge of the basic principles, methods and technical means of rational use of electricity and reduction of energy losses in the power supply system of an industrial enterprise, as well as the provision of consumers with electricity at a normalized quality, reliability and efficiency |
| **Current control** | Graphical design and calculation works 1, final test 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, lab facilities. |
| **References** | 1. С. И. [Малафеев](https://www.labirint.ru/authors/178090/)  Надежность электроснабжения. Учебное пособие, Издательство: [Лань](https://www.labirint.ru/pubhouse/73/), 2018 г.,[https://www.labirint.ru/books/569736](https://www.labirint.ru/books/569736/) 2. Васильева Надежность электрооборудования и систем электроснабжения, М.: Горячая линия – Телеком, 2017. 152 с., <https://www.twirpx.com/file/2339027/> 3. В. Н. Галушко, С. Г. Додолев, Надежность электроустановок и энергетических систем, учебно-методическое пособие Гомель 2014, <https://www.bsut.by/images/MainMenuFiles/Obrazovanie/Kafedry/Elektrotehnika/inf_material/uch_metodich/nadejnost_ustanovok_isistem.pdf> 4. [Хорольский В. Я.](https://ruslania.com/ru/knigi/avtory/155148-horolskij-v-ja/), [Таранов М. А.](https://ruslania.com/ru/knigi/avtory/155149-taranov-m-a/), Надежность электроснабжения, Учебное пособие, Изд. [Дрофа](https://ruslania.com/ru/knigi/izdatelstva/188-drofa/), [2013](https://ruslania.com/ru/knigi/goda/2013/), 128 с., <https://knigabook.com/books/nadezhnost-elektrosnabzheniya-uchebnoe-posobie--horolskij-vladimir-yakovlevich-taranov-mihail-alekseevich-2198368> 5. Разгильдеев, Г. И. Надежность электромеханических систем и электрооборудования: учеб. Пособие, ГОУ ВПО «Кузбас. гос. техн. ун­т». - Кемерово, 2008. - 175 с., [https://www.twirpx.com/file/409599](https://www.twirpx.com/file/409599/) |

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| **Module name** | **MEE-M20-2 “Optimization and reliability in the power industry”** |
| **Semester(s), in which the module is taught** | 3 |
| **Person, responsible for the module** | Professor G. G. Trofimov |
| **Language** | Russian |
| **Relation to curriculum** | **Variative** with“Methods of analysis and evaluation of reliability in the electric power industry” |
| **Teaching methods** | Lectures, practical seminars, individual work of master students under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 90 hours  **Class hours:**  Lectures - 15; practice - 15; SSW - 54; MSWS – 5  **Examination preparation hours:** 6 |
| **Credits** | 3 |
| **Required and recommended pre-requisites for joining the module** | "Higher Mathematics,  "Theoretical Foundations of Electrical Engineering",  "Theory of modeling and scientific experiment". |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  mastering the knowledge on the analysis of the causes of damage of electrical equipment and reducing the reliability of power supply systems, the study of methods and ways of optimization and reliability in the power industry.  **LEARNING OUTCOMES:**  Bachelors know:  - causes of failure of electrical equipment and power supply systems;  - impact of various factors on the reliability of electrical equipment and power supply systems;  - methods for determining the shortfall of electricity and damage from interruptions in electricity supply, methods of optimizing reliability, methods and means of improving the reliability and uptime of technical systems;  - basic questions of organization and planning of researches on reliability.  know how to:  make up substitution diagrams for reliability calculation and analysis and determine quantitative indicators of reliability of electrical equipment, typical schemes of switchgear, real power facilities and power supply systems;  - apply modern methods of mathematical analysis and modeling to determine the reliability of electrical equipment and power supply systems in the design and operation, apply the reliability models of electrical installations depending on the task and determine the damage from power outages and power limitation of consumers;  **COMPETENCIES:**  - Apply regulatory documents in practice and be guided by them in solving technical issues of production;  - Organize and perform maintenance of power supply systems with an appropriate degree of reliability. |
| **Content** | Formation of steady knowledge on the problematic issues of power supply systems in various industries, energy conservation, reliability of power supply systems. Applicability of the main mathematical methods for calculating the reliability of power supply systems, for analyzing the reliability of individual power supply systems, the main ways of increasing the operational reliability of the power supply systems |
| **Current control** | Graphical design and calculation works 1, final test 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, laboratory equipment |
| **References** | 1. С. И. [Малафеев](https://www.labirint.ru/authors/178090/)  Надежность электроснабжения. Учебное пособие, Издательство: [Лань](https://www.labirint.ru/pubhouse/73/), 2018 2. Васильева Надежность электрооборудования и систем электроснабжения, М.: Горячая линия – Телеком, 2017. 152 с., <https://www.twirpx.com/file/2339027/> 3. В. Н. Галушко, С. Г. Додолев, Надежность электроустановок и энергетических систем, учебно-методическое пособие Гомель 2014, 4. [Хорольский В. Я.](https://ruslania.com/ru/knigi/avtory/155148-horolskij-v-ja/), [Таранов М. А.](https://ruslania.com/ru/knigi/avtory/155149-taranov-m-a/), Надежность электроснабжения, Учебное пособие, Изд. [Дрофа](https://ruslania.com/ru/knigi/izdatelstva/188-drofa/), [2013](https://ruslania.com/ru/knigi/goda/2013/), 128 с., 5. Разгильдеев, Г. И. Надежность электромеханических систем и электрооборудования: учеб. Пособие, ГОУ ВПО «Кузбас. гос. техн. ун­т». - Кемерово, 2008. - 175 с., |

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| **Module name** | **MEE-M13-1 “Complexes of electric power systems using renewable energy sources with cyclical changes in wind potential”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | Professor Trofimov G.G. |
| **Language** | Russian |
| **Relation to curriculum** | **Compulsory / variable / specialization**  Specialization «**Alternative /non- conventional and renewable energy sources**» |
| **Teaching methods** | Lectures, practical seminars, laboratory work, coursework,  Independent work of a master's student under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -30; practical classes -15; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Higher Mathematics, Theoretical Foundations of Electrical Engineering, Electrical grids and systems. |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  to study the properties and characteristics of electric power systems using RES in normal and emergency modes, to analyze their integration and ways to ensure the stability of operation.  **LEARNING OUTCOMES:**  **Knowledge:** - basic characteristics of RES;  - hydroelectric power plants;  - solar power plants;  - wind farms.  - elements of power electronics used in electric power industry.  **Be able to** - calculate power supply systems with RES;  - to carry out an economic assessment of the feasibility of integrating RES into the power system;  - select and calculate PA and relay protection devices.  **COMPETENCIES:**  - Apply regulatory documents in practice and be guided by them when dealing with technical issues of production;  - Organize and perform maintenance of power supply systems. |
| **Content** | The features of electric power systems with a wide share of generation from RES are described. The main reasons hindering the integration of RES into the energy system are studied. The revolutionary transformations that took place in the energy systems after the appearance of RES in them are considered. The features of modern decentralized energy systems with distributed generation working autonomously or in isolated mode are described. The features of energy converters and accumulators and their role in the integration of renewable energy sources into the energy system are described. |
| **Current control** | Calculated graphic work 1, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, laboratory facilities. |
| **References** | 1. Энергетические установки на базе нетрадиционных и возобновляемых источников энергии: Методические рекомендации / Арбузова Е.В., Немихин Ю.Е., Щеклеин С.Е., - 2-е изд., стер. - М.:Флинта, 2018. - 58 с.: ISBN 978-5-9765-3538-1 - Режим доступа: http://znanium.com/catalog/product/965368.;  2. Возобновляемые источники энергии / Удалов С.Н. - Новосиб.:НГТУ, 2014. - 459 с.: ISBN 978-5-7782-2467-4 - Режим доступа: http://znanium.com/catalog/product/556622;  3. Мировая энергетическая революция. Как возобновляемые источники энергии изменят наш мир / Сидорович В. - М.:Альпина Пабл., 2016. - 208 с.: 60x90 1/16 (Переплёт) ISBN 978-5-9614-5249-5 - Режим доступа: http://znanium.com/catalog/product/914424;  4. В поисках энергии: Ресурсные войны, новые технологии и будущее энергетики / Ергин Д. - М.:Альпина Пабл., 2016. - 712 с.: ISBN 978-5-9614-4379-0 - Режим доступа: http://znanium.com/catalog/product/912389  5. Накопители энергии, Национальный исследовательский университет «Высшая школа экономики», https://energy.hse.ru/accenergy  6. Гидроэнергетика / Филиппова Т.А., Мисриханов М.Ш., Сидоркин Ю.М. - Новосиб.:НГТУ, 2013. - 620 с.: ISBN 978-5-7782-2209-0 - Режим доступа: http://znanium.com/catalog/product/557101 |

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| **Module name** | **MEE-M14-1 “Dynamic characteristics of air currents and wind as an energy carrier for system and autonomous energy”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | Associate Professor K. A. Bakenov |
| **Language** | Russian |
| **Relation to curriculum** | **Compulsory / variable / specialization**  Specialization «**Alternative /non- conventional and renewable energy sources**» |
| **Teaching methods** | Lectures, laboratory work, three calculation and graphic work,  independent work of the master's student under the guidance of the teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; laboratory work -30; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | 1) Theory of modeling and scientific experiment or  Fundamentals of modeling and data processing of scientific and engineering experiment;  2) Scientific and technical problems of the electric power industry |
| **Module objectives/intended learning outcomes** | **PURPOSE OF THE MODULE:** to form knowledge about the wind potential, the theory of wind turbine operation, the influence of the dynamic characteristics of wind on the energy parameters and the features of power delivery to the power system.  **MODULE OBJECTIVES**:  the formation of pedagogical competence, the ability for pedagogical activity in universities based on the knowledge of didactics of higher education, the theory of education and management of education, analysis and self-assessment of teaching activities.  **LEARNING OUTCOMES:**  **Knowledge:**  - the nature of the occurrence of winds, wind potential of Kazakhstan.  - the main characteristics of wind, to assess the wind potential;  - the principle of wind engines, aerodynamic characteristics of various wind engine designs;  - The influence of the dynamic characteristics of wind on its performance (KIEV);  - static and dynamic characteristics of the wind.  **Be able to**  - perform statistical data processing to calculate gross and technical wind potential;  - conduct aerodynamic calculations of wind turbines with vertical axis of rotation;  - to work with software that allows, to estimate the performance of wind power plants;  **COMPETENCIES:**  - Apply hands-on methods of performing statistical data processing to calculate wind potential, and wind turbine performance;  - Analyze the operation of wind turbines with a vertical axis of rotation. |
| **Content** | The nature of wind. Characteristics of wind as an energy carrier. The influence of external factors on the nature of air currents. The study of methods of statistical processing of weather data and evaluation of the potential. Consideration of promising sites for the location of wind turbines in Kazakhstan. The study of modern design of wind turbines. Wind power units, wind turbines and multi-aggregate wind power plants. Small capacity wind power units for individual use. Wind power units for power generation in power systems. Features of operation modes of wind turbines. Aerodynamic and power characteristics of wind turbines. Influence of wind dynamic characteristics on power characteristics of wind turbines. Characteristics of wind-powered units for power generation in power systems. Static and dynamic characteristics of wind engines. |
| **Current control** | Calculated graphic work 3, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, laboratory base. |
| **References** | 1. Ryan Wiser, Mark Bolinger1, Ben Hoen, Dev Millstein, Joe Rand, Galen Barbose, Naïm Darghouth, Will Gorman, Seongeun Jeong, Andrew Mills, Ben Paulos  Lawrence Berkeley National Laboratory. Wind Energy Technology Data Update: 2020 Edition. windreport.lbl.gov.  2. Безруких П.П., Безруких П.П. (мл.), Грибков С.В. Ветроэнергетика: Справочнометодическое издание / Под общей редакцией П.П. Безруких. — М.: «Интехэнерго- Издат», «Теплоэнергетик», 2014. — 304 с.  3. Hansen, Martin O. L. Aerodynamics of wind turbines. 22883 Quicksilver Drive, Sterling, VA 20166-2012, USA. I. Title.TJ828.H35 2007  4. Болотов А. В., Новокшенов В.С., Ганага Е.Ф., Бакенов К.А. Патент Республики Казахстан № 8086, Вентильный генератор, бюл.№ 12, 2003.  5. International Conference & Expo on Advances in Power Generation from Renewable Energy Sources ISBN-978-81-932091-2-7. International Conference & Expo on “Advances in Power Generation from Renewable Energy Sources (APGRES 2017)” December  22-23, 2017 at GEC Banswara, www.apgres.in  6. Dynamic Models for Wind Turbines and Wind Power Plants January 11, 2008 – May 31, 2011.  7. Быстрицкий Г.Ф.. Основы энергетики: Учебник - Москва, ИНФРА-М, 2006г. |

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| **Module name** | **MEE-M8-1 “Solar power and geothermal power”** |
| **Semester(s), in which the module is taught** | 1 |
| **Person, responsible for the module** | Tergemes K.T. Candidate of Technical Sciences, Assoc. Prof. |
| **Language** | Russian |
| **Relation to curriculum** | **Compulsory / variable / specialization**  Specialization **“Alternative /non- conventional and renewable energy sources”** |
| **Teaching methods** | Lectures, practical classes, three calculation-graphic works,  Independent work of the master's student under the guidance of the teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -30; practical classes -15; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Undergraduate program courses: "Theoretical Foundations of Nonconventional and Renewable Energy Installations", "Comprehensive Assessment of Renewable Energy Resources of Nonconventional and Renewable Energy Installations", "Design of Small Power Supply Systems Using Renewable Energy" |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  Formation of professional knowledge, abilities and practical skills in the field of solar and geothermal energy. To master the methods of modeling and optimization of technical solutions in the field of geothermal and solar energy.  **LEARNING OUTCOMES:**  **Knowledge:** - Status and trends of solar and wind energy development in the world and  - The main information sources of solar energy. Solar radiation on the surface of the Earth.  - Methods of calculation of solar energy resources. Some questions of the theory of heat exchange  **Be able to** - assess the geothermal potential of territories;  - Evaluate the impact of geothermal plants on the environment, their location, taking into account environmental and other requirements and constraints;  Analyze and determine the optimal systems of combined energy supply on the basis of SES, MGES.  **COMPETENCIES:**  - Apply knowledge, understanding, and the ability to solve problems in new or unfamiliar situations.  - apply regulatory documents in practice and be guided by them when solving technical issues of production;  - organize and perform maintenance of complex power plants, measuring and controlling operating modes.  - to be competent in performing scientific projects and research in professional area. |
| **Content** | Mastering the knowledge of the achievements of modern solar and geothermal energy and methods of calculation of solar and geothermal power plants. Conversion of geothermal and solar energy into electrical and thermal energy and study of the electrical equipment of solar and geothermal plants |
| **Current control** | Calculated graphic work 3, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, laboratory base. |
| **References** | 1. Авезов Р.Р., Орлов А. Ю. Солнечные системы отопления и горячего водоснабжения Ташкент: Фан 1988 г  2. Лидоренко Н.С., Евдокимов В.М., Стребков Д.С. Развитие фотоэлектрической энергетики. - М., Информэлектро, 1988  3. Преобразование геотермальной энергии в электрическую с использованием во вторичном контуре сверхкритического цикла. Абдулагатов И.М., Алхасов А.Б. "Теплоэнергетика. - 1988№4-стр.53-56".  4. Алхасов А.Б. "Повышение эффективности использования геотермального тепла" Теплоэнергетика-2003–№3-стр.52-54.  5. Андреев С. В. Солнечные электростанции - М.: Наука 2002  6.. Базаров Б. А., Заддэ В.В., Стебков Д.С. и др. Новые способы получения кремния солнечного качества. Сб. "Солнечная фотоэлектрическая энергетика". Ашхабад, 1983  7.. Грабмайер И.Г. "Сименс". Дешевое изготовление качественного солнечного кремния и листового кремния для солнечных элементов. Труды 7 международной конференции по использованию солнечной энергии 9-12 октября 1990 г. Франкфурт, Германия.  8.. Лидоренко Н.С., Евдокимов В. М., Стребков Д.С. Развитие фотоэлектрической энергетики. - М., Информэлектро, 1988 |

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| **Module name** | **MEE-M15-1 “Power electrical equipment for autonomous and system use installations”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | Hidolda E., Ph.D., senior lecturer |
| **Language** | Kazakh, Russian |
| **Relation to curriculum** | **Compulsory / variable / specialization**  Specialization **“Alternative /non-conventional and renewable energy sources”** |
| **Teaching methods** | Lectures, practical seminars, independent work of the master under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -30; practical classes -15; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | "Theoretical Foundations of Electrical Engineering," "Use of Renewable Energy Sources," "Alternative Energy and Energy Saving Technologies," "Theory of Modeling and Scientific Experiments |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  studying the principles of selecting power equipment and designing power supply systems for remote consumers using renewable energy facilities.  **LEARNING OUTCOMES:**  **Knowledge:** - basic requirements applicable to autonomous power supply systems;  - basic issues of effective use of power equipment in autonomous power supply facilities;  - stages of design of various renewable energy facilities.  **Be able to** - design an autonomous power supply system using RES facilities;  - design power electrical equipment of RES facilities;  - make technical and economic calculations in autonomous power supply systems.  **COMPETENCIES:**  - Installation of power electrical equipment for remote consumers;  - construction of power supply schemes of autonomous object with the help of RES;  - work with documentation when designing systems of autonomous power supply of facilities. |
| **Content** | Preparation of a specialist capable of performing the entire list of tasks associated with the study of the technology of converting energy from inexhaustible, renewable sources of energy into electrical energy. Mastering the knowledge of modern methods of converting non-exhaustible, renewable energy sources into electricity and methods of calculating their potential. |
| **Current control** | Calculated graphic work 3, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software. |
| **References** | 1. Основное и вспомогательное оборудование нетрадиционной и возобновляемой энергетики / О.В.Григораш, Е.А.Денисенко. – Краснодар: КубГАУ, 2018, -129 стр.  2. Возобновляемая энергетика в современном мире: учебное пособие / О.С.Попель, В.Е.Фортов. – М.: Издательский дом МЭИ, 2015. – 450 стр.  3. Теоретические основы нетрадиционной и возобновляемой энергетики / Р.А.Амерханов, О.В.Григораш, Е.А.Денисенко, А.Е.Усков. – Краснодар: КубГАУ, 2019, -296 стр.  4. Возобновляемая энергетика / Э.А.Бекиров. – Симферополь: ИТ «Ариал»,2016, - 384 стр. |

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| **Module name** | **MEE-M21-1 “Synthesis and automatic control of hybrid electric power systems”** |
| **Semester(s), in which the module is taught** | 3 |
| **Person, responsible for the module** | E.A. Abdrakhmanov, Professor, doct.tech.sci. |
| **Language** | Russian |
| **Relation to curriculum** | **Compulsory / variable / specialization**  Specialization «**Alternative /non- conventional and renewable energy sources**» |
| **Teaching methods** | Lectures, practical work, calculation and graphic work,  independent work of the master's student under the guidance of the teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -30; practical classes -15; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Undergraduate program courses: "Theoretical Foundations of Nonconventional and Renewable Energy Installations," "Comprehensive Assessment of Renewable Energy Resources of Nonconventional and Renewable Energy Installations," "Design of Small Power Supply Systems Using Renewable Energy |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  Teaching students how to manage hybrid electric power systems  **LEARNING OUTCOMES:**  **Knowledge:**  -combined operation of hybrid plants based on various RES;  - ways of determining the conomic efficiency of using RES;  - ways of automatic control of hybrid electric power plants.  **Be able to**  - are able to analyze and calculate the economic resource of RES;  - are able to carry out the necessary calculations when using non-traditional energy sources, design hybrid power systems.  **COMPETENCIES:**  - Ability to determine the industrial process efficiency of electric and electrical facilities. |
| **Content** | Studying the issues of parallel operation of plants based on different RES, finding solutions to improve the stability of hybrid systems. Synthesis and automatic control of hybrid power systems. The problems of organizing the automatic control of hybrid power systems and modern ways of their solution, for use in solving applied problems |
| **Current control** | Calculated graphic work 3, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, laboratory base. |
| **References** | 1. Қойшиев Т.Қ. Жаңғыртылатын энергия көздері: оқулық; ҚР білім және ғылым министрлігі, ҚР жоғары оқу орындарының қауымдастығы.- Алматы, 2013.- 256 .  2. Тлеуов А.Х. Нетрадиционные источники энергии. – Астана: Фолиант, 2009. – 248 с.  3. Ершина, А.К. Теория и практика использования возобновляемых источников энергии - Алматы: Эверо, 2016.- 220 с. 3.  4. Голицын М.В., Голицын А.М., Пронина Н.М. Альтернативные энергоносители, - М.: Наука. – 2004. – 157 с.  5. Burton Tony. Wind power — Handbooks, by John Wiley & Sons, Ltd Baffins Lane, Chichester West Sussex, PO19 1UD, England. 2001. – 609 р. |

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| **Module name** | **MEE-M13-2 “Modern electric drive of oil pumping and compressor stations of oil and gas pipelines”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | Doc.Tech.Sci., Professor Mustafin M. A. |
| **Language** | Russian |
| **Relation to curriculum** | **Compulsory**  Specialization “**Electric drive and automation of industrial plants”** |
| **Teaching methods** | Lectures, laboratory work, practical classes, calculation and graphic work, independent work of the master under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; laboratory work – 15; practical classes -15; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | "Scientific and Technical Problems of the Electric Power Industry" |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  mastering the properties and characteristics of systems of automatic electric drive of oil pumping and compressor stations of oil and gas pipelines, methods of calculation of parameters, static and dynamic characteristics, the choice of its elements.  peculiarities of electric drive operation on centrifugal load, methods of analysis and synthesis of energy-saving modes of operation. **LEARNING OUTCOMES:**  **Knowledge:** - modern and prospective directions of electric drive development in oil and gas sector;  -requirements for electric drive systems for centrifugal mechanisms;  -the principle of operation, characteristics and design features of electric drives used in oil and gas pipelines.  -methods of research of processes occurring in regulated electric drives with centrifugal load;  -modern circuit solutions and the principle of operation of converters used in regulated electric drives of oil pumping stations;  **Be able to** -Evaluate the efficiency and select the type of regulated electric drive for specific mechanisms;  -Analyze processes of controlling operating modes of oil pumping and compressor stations by means of an automated electric drive;  -Make a preliminary calculation and power selection of the main elements of the electric drive.  **COMPETENCIES:**  - Analyze modes of operation of electric drives of oil pumping and compressor stations to optimize energy consumption;  - Propose energy-saving measures by means of automated electric drives;  -calculate and assess the electromechanical and operational characteristics of electric drive systems for oil and gas pipelines;  - justify the proposed electric drive systems both at the design stage of new facilities and during the modernization of existing ones. |
| **Content** | The basic laws of the course of electromagnetic and electromechanical processes in the systems of frequency-controlled asynchronous electric drive of centrifugal pumps and gas-pumping units during oil and gas transportation are considered. Mathematical models of electric drives taking into account properties of converters, electric motors, pumping and compressor units and pipelines are given. The research is carried out with the use of mathematical computer applications "Mathcad" and MATLAB Simulink, as well as on the research bench. |
| **Current control** | Calculated graphic work 3, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, laboratory base. |
| **References** | 1. Ухин Б.В. Насосы, вентиляторы, компрессоры и гидропривод. – М.: «Форум», «Инфра-М», 2011  2. Москаленко В.В. Автоматизированный электропривод. – М.: Энергоатомиздат.-2012.  3. Мустафин М.А., Алмуратова Н.К., Табултаев С.С. Энергосберегающий электропривод центробежных нососов. Учебное пособие. - Алматы, АУЭС- 2016  4. Сагитов П.И. Автоматизированный электропривод промышленных механизмов.- Алматы, 2012.  5. Мустафин М.А., Алмуратова Н.К. Электропривод нефтеперекачивающих и компрессорных станций нефтегазопроводов. - Алматы, 2013.  6. Мустафин М.А., Мустафин Е.М. Энергосберегающие системы электропривода центробежных насосных агрегатов.-Алматы, 2009.-248с.  7. Браславский И.Я. Энергосберегающий асинхронный электропривод. М.: «Академия», 2004.  8. M.Mustafin, N. Almuratova. Calculation of transient processes of electric drives of centrifugal mechanisms. International Journal of Pharmacy & Technology. IJPT| Sep-2016 | Vol. 8 | Issue No.3 | Indian. |

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| **Module name** | **MEE-M14-2 “Methods for modeling components of electrical complexes and systems”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | Doc. Tech. Sci., Professor M. A. Mustafin |
| **Language** | Russian |
| **Relation to curriculum** | **Compulsory**  Specialization «**Electric drive and automation of industrial plants**» |
| **Teaching methods** | Lectures, laboratory work, practical classes, calculation and graphic work, independent work of the master under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; laboratory work-15; practical classes -15; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | "Scientific and Technical Problems of the Electric Power Industry" |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  master simulation methods, which will allow you to successfully study and research the static and dynamic processes of the components of electrical complexes and systems, the study of numerical methods for modeling control systems of AC and DC electric drives, the characteristics of use in various technological systems and methods of assessment of their effectiveness.  **LEARNING OUTCOMES:**  **Knowledge:** - variants of analytical description of the elements of electrical engineering systems;  - methods of simulation modeling of elements of electrical systems;  -modern computer mathematical applications (Mathcad, MATLAB and similar);  - methods of solving differential equations and systems of differential equations;  **Be able to** - make conceptual models of components of electrical complexes and systems;  - formalize models of elements of electrical complexes and systems, taking into account assumptions;  - implement models using modern mathematical computer applications;  - process and interpret simulation results;  **Competencies:**  -model electromagnetic and electromechanical processes in the equipment of electrical systems;  - to choose reasonably the methods and means of modeling depending on the tasks set.  - use mathematical models of electrical equipment at the stage of design of new objects and modernization of existing ones;  - effectively use modern computer and information technologies, digital techniques and software in solving scientific and technical problems of electric power industry, have skills of modeling elements of electric power systems and work with modern computer programs. |
| **Content** | Ways of modeling elements of electrical complexes using modern computer applications, the process of modeling from object description to compiling a mathematical model and conducting the experiment are studied, methods of statistical processing of modeling results are considered. In the process of training the most modern versions of mathematical computer applications "Mathcad" and "MatLAB" are used. |
| **Current control** | Calculated graphic work 3, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, laboratory base. |
| **References** | 1. Черных И.В. Моделирование электротехнических устройств в MATLAB, SimPowerSystems и Simulink. – М.: ДМК Пресс; СПб.: Питер, 2008. – 288 с.  2. Герман – Галкин С.Г. Matlab & Simulink. Проектирование мехатронных систем на ПК. – СПб.: КОРОНА – Век, 2008. – 368 с..  3. Терехов В.М., Осипов О.И. Системы управления электроприводов. – М.: Издательский. центр «Академия», 2008. – 304 с.  4. Браславский И.Я., Ишматов З.Ш., Поляков В.Н. Энергосберегающий асинхронный эдектропривод. – М.: Издательский. центр «Академия», 2004. – 256 с.  5. Розанов Ю.К., Соколова Е.М. Электронные устройства электромеханических систем. – М.: Издательский. центр «Академия», 2004. – 272 с.  6 Соколовский Г.Г. Электроприводы переменного тока с частотным регулированием.-М.:, Издательский центр «Академия» 2007г.  7 Белов М.П., Новиков В.А., Рассудов Л.Н. Автоматизированный электропривод типовых производственных механизмов и технологических комплексов- М.: Издательский центр «Академия» 2004 г. |

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| **Module name** | **MEE-M8-2 “Energy saving by means of automated electric drives”** |
| **Semester(s), in which the module is taught** | 1 |
| **Person, responsible for the module** | Doc. Tech. Sci., Professor M. A. Mustafin |
| **Language** | Russian |
| **Relation to curriculum** | **Compulsory**  Specialization «**Electric drive and automation of industrial plants**» |
| **Teaching methods** | Lectures, laboratory works, calculation and graphic works,  Independent work of undergraduates under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; practical classes -30; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | "Scientific and Technical Problems of the Electric Power Industry" |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  Master's students will master the principles of construction and methods of realization of energy-saving systems of automatic electric drive for different technological processes.  **LEARNING OUTCOMES:**  **Knowledge:**  - factors affecting energy consumption at industrial enterprises;  - issues of saving energy consumption when introducing regulated electric drives at technological facilities;  - methods for calculating the energy performance of electric drives and process plants;  - modern energy-efficient systems of automated electric drive by the world's leading manufacturers.  **Be able to**  -present possible ways to reduce energy consumption at the facilities of industrial enterprises;  -to carry out the construction and analysis of load diagrams;  - Evaluate the feasibility of energy-saving measures with the use of a regulated electric drive;  -to select technical solutions when designing.  **Competencies:**  - be able to apply normative documents in practice and be guided by them when controlling the modes of operation of electric drives;  - analyze and recommend basic measures to minimize losses in technological processes by means of automated electric drives;  - to choose energy-efficient systems and schemes of automated electric drive optimum for given mechanisms in the process of designing new and modernization of existing electric drives;  - determine the least energy-intensive modes of operation of electric drives of various mechanisms. |
| **Content** | The course deals with possible ways and ways, general principles and means of energy saving in electric drive and means of automated electric drive. Outlines the optimization of electric drives of direct and alternating currents on electricity consumption and the main aspects of energy saving. The economic and technical issues of designing electric drives of industrial plants in energy-saving modes are considered. |
| **Current control** | Calculated graphic work 3, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, laboratory base. |
| **References** | 1 Юсупова С.А Чигамбаев Т.О. Системы автоматизированного электропривода. Учебное пособие. – Алматы: 2019 – 157 с  2 Энергосберегающий электропривод центробежных насосов: Учебное пособие (для магистрантов специальности «Электроэнергетика») /М.А.Мустафин, Н.К.Алмуратова, С.С. Табултаев. –Алматы: АУЭС, 2016.  3 C.Б. Алексеев, И.Т. Алдибеков. Энергосбережение средствами автоматизированного электропривода. Методические указания по выполнению лабораторных работ для магистрантов специальности 6М071800 - Электроэнергетика. – Алматы: АУЭС, 2019. – 45 с.  4 Свидерская О.В.Основы энергосбережения. М., Энергия 2013.  5 Арутюнян А.А. Основы энергосбережения М., Энергия 2014.  6 Н.Ф. Ильинский. В.В. Москаленко. Электропривод, энерго – и ресурсосбережение. - М., «Академия», 2012.  7 И.Я. Браславский. З.Ш. Ишматов. В.Н. Поляков. Энергосберегающий асинхронный электропривод. - М., «Академа», 2014.  8 Полонский В.М. Энергосбережение. М.: «Энас» 2015.  9 Сагитов П.И. Автоматизированный электропривод типовых промышленных механизмов. - Учебное пособие, Алматы, АИЭС, 2005.  10 Сагитов П.И. Энергосбережение средствами автоматизированного электропривода. Учебное пособие. АУЭС 2011.  11 Сагитов П.И. Энергосбережение средствами автоматизированного электропривода. Конспект лекции. АУЭС 2010.  12 П.И. Сагитов, Н.К. Алмуратова. Энергосбережение средствами автоматизированного электропривода. Методические указания к курсовой работе для магистрантов специальности 6М071800 – Электроэнергетика, специализации ЭАТК - Алматы: АУЭС, 2012. - 11 с. |

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| **Module name** | **MEE-M15-2 “Frequency-controlled electric drives in the automatic control system”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | Associate Professor, PhD Shynybay Zh. S. |
| **Language** | Russian |
| **Relation to curriculum** | Specialization «**Electric drive and automation of industrial plants**» |
| **Teaching methods** | Lectures, practical work, laboratory work, calculation and graphic work, independent work of the master under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; laboratory work-15; practical classes -15; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | "Scientific and Technical Problems of the Electric Power Industry" |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  mastering the principles of building process control systems based on frequency-controlled electric drive (VFD) and knowledge of their technical and economic advantages.  **LEARNING OUTCOMES:**  **Knowledge:**  - principles of formation of output voltage of frequency converters (FC), laws of frequency regulation and areas of their application;  - electromagnetic phenomena occurring in semiconductor frequency converters;  -main parameters and characteristics of frequency converters;  - calculation methods of technical and economic efficiency in the automation of technological processes on the basis of VFD;  **Be able to**  -evaluate the efficiency, choose the type of frequency converter and the law of frequency regulation for the electric motor of a particular mechanism;  -analyze control processes of technological processes, calculate parameters of control system;  -to make programming and adjustment of modern frequency converters. **Competencies:**  - selecting the type and power of VFDs for specific process units:  -justification of technological process modernization with the use of modern and advanced VFD systems;  selection of power schemes of frequency converters and their element base;  - calculation of technical and economic efficiency of VFD in the automation of technological processes. |
| **Content** | The discipline provides an opportunity to study the theoretical foundations of the construction of frequency-controlled electric drive, the principles of scalar and vector control systems, the interaction of electric drive with elements of ACSPS. Expanding the field of application of variable frequency drives in the industrial sphere requires training of highly qualified specialists with skills of programming, diagnostics and adjustment of control systems with VFD. |
| **Current control** | Calculated graphic work 3, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, laboratory base. |
| **References** | 1. Г.Г. Соколовский. Электропривод переменного тока с частотным регулированием: учебник для студ. высш. учеб. заведений. – М.: Издательский центр «Академия», 2007. – 272с.  2. Алексеев С.Б. Частотно-регулируемый электропривод в автоматизированных системах управления технологическими процессами. Конспект лекций.-Алматы: АУЭС, 2013 г.  3. Лезнов Б.С. “Энергосбережение и регулируемый электропривод в насосных и воздуходувных установках” - М.:- Энергоатомиздат, 2006 г.-360с.  4 Белов М.П., Новиков В.А., Рассудов Л.Н. Автоматизированный электропривод типовых производственных механизмов и технологических комплексов: Учебник для вузов. – М.: Издательский центр «Академия», 2004 г. – 576 с.  5. Алексеев С.Б Силовые преобразовательные устройства. Учебное пособие.- Алматы: АИЭС, 2006г-90с.  6 Алексеев С.Б. Силовые преобразовательные устройства и микропроцессорные системы. Методические указания к выполнению лабораторных работ.- Алматы: АИЭС, 2008г. |

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| **Module name** | **MEE-M21-2 “Non linear and digital ACS”** |
| **Semester(s), in which the module is taught** | 3 |
| **Person, responsible for the module** | Associate Professor, PhD Almuratova N. K. |
| **Language** | Russian |
| **Relation to curriculum** | **Compulsory**  Specialization "**Electric drive and automation of industrial plants”** |
| **Teaching methods** | Lectures, practical work, laboratory work, calculation and graphic work, independent work of the master under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; laboratory work-15; practical classes -15; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | "Scientific and Technical Problems of the Electric Power Industry" |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  mastering of methods of analysis and synthesis of various types of nonlinear digital automatic control systems  **LEARNING OUTCOMES:**  **Knowledge:**  - composition and structure of digital control systems;  -typical static nonlinearities;  -phase space and phase planes;  -methods of linearization of control systems;  **Be able to**  -evaluate the stability of the EF control system movement;  -determine the stability of the EF control system by Lyapunov method;  -calculate the transients of EF using MATLAB system.  **Competencies:**  - select measuring instruments, adjust and measure technological parameters of nonlinear and digital automatic control systems;  - analyze reference and normative literature, design technical documentation;  - develop technical support for automated process control systems. |
| **Content** | The principles of construction, methods of linearization and synthesis of nonlinear and digital automatic control systems for the purpose of optimization of control processes are offered. Modern digital systems with numerical programmed and optimal adaptive control with the use of computers and microprocessor technology are considered. The study of these systems is carried out in the programmable complex MATLAB with extensions Control System Toolbox Simulink. |
| **Current control** | Calculated graphic work 3, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, laboratory base. |
| **References** | 1. Бесекерский В.А. Теория систем автоматического управления.- СПб. 2017.  2. Терехов В. М, Осипов О.И. Системы управления электроприводов (учебник вузов) М.: Издательский центр «Академия» 2018. – 304 с.  3. Парк Дж. Передача в системах контроля и управления.-М., 2007.  4. Цыба Ю.А., Шадхин Ю.И. Нелинейные и цифровые системы автоматического управления. Учебное пособие. АУЭС 2013.  5. Цыба Ю.А. «Автоматическое управление электромеханическими системами» (Учебное пособие). Алматы: АУЭС. 2008г.-77с.  Интернет ресурсы:  6. Электронно-библиотечная система издательства «Лань». – Режим доступа: http://e.lanbook.com/.  7. Официальный сайт научно-технической библиотеки СГГА. – Режим доступа: http://lib.ssga.ru/.  8. Электронно-библиотечная система научно-издательского центра «ИНФРА-М». –Режим доступа: http://znanium.com/.  9. http://bookash.pro/ru |

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| **Module name** | **MEE-M8-3 “The main problems of operating electrical grids and systems”** |
| **Semester(s), in which the module is taught** | 1 |
| **Person, responsible for the module** | Cand.Tech. Sci., Associate Professor Yer. K. Umbetkulov |
| **Language** | Russian |
| **Relation to curriculum** | **Compulsory / variative / specialization**  Specialization **“Electricity Grid Systems”** |
| **Teaching methods** | Lectures, practical seminars, calculation and graphic work, independent work of the master under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; practical classes -30; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module**  **(Prerequisites)** | Scientific and technical problems of the electric power industry |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVE:** Master's students have mastered the knowledge on  Management of electric power system operation modes and operation of its main power equipment  **LEARNING OUTCOMES:**  **Knowledge:**  - the concept of development of the electric power industry of the Republic of Kazakhstan;  - the management structure of the electric power system;  - the main problems of operation of the electric power system;  - peculiarities of normal, emergency and post-emergency  management of normal, emergency and post-emergency modes of operation of power systems;  - basic measures to prevent and eliminate technological prevention and elimination of technological failures in the power system;  - basics of operating elements of electric power plants and electric networks.  **Be able to:**  - Analyze power system operation modes;  - plan electrical loads and manage the modes of operation of electric power systems;  - Take effective measures to prevent and eliminate technological failures in electric power systems;  - Develop plans to repair main and auxiliary electrical equipment of the power system.  **OMPETENCIES:**  - is able to apply normative documents in practice and be guided by them when solving the issues of managing the modes of operation of electric power systems and the operation of their power equipment;  - Analyze and recommend basic measures to prevent and eliminate technological failures in the power system;  - can develop plans for the repair of main and auxiliary electrical equipment of electric power systems. |
| **Content** | Familiarization with the problems associated with the operation of electrical networks and systems at all hierarchical levels of energy management, the principles of calculation, design and operation of their electrical equipment, as well as acquiring the skills of dispatcher control of energy facilities and dispatcher actions in emergency situations. |
| **Current control** | Calculated graphic work -3, boundary control 2, tests |
| **Final control** | Экзамен |
| **Study and examination requirements** | Personal computer, software, laboratory base. |
| **Literature** | 1. Красник В.В. Эксплутация электрических подстанций и распределительных устройств. М.: Энас., 2012 г.  2. Акимова Н.А., Котеленец Н.Ф, Сентюрихин Н.И. Монтаж, техническая эксплуатация и ремонт электрического и электромеханического оборудования. М.: Академия, 2008г.  3. Соколов С.Е., Михалкова Е.Г. Основные проблемы эксплуатации  электричесуких сетей и систем. Конспект лекций для специальности 6М071800– Электроэнергетика (научно-педагогическая магистратура). - Алматы, НАО АУЭС, 2016. – 60с.  4. Соколов С.Е., Михалкова Е.Г. Эксплуатация электрических сетей и систем. МУ и задания к выполнению расчетно-графических работ. Алматы,  АУЭС, 2011 г.  5. Михеев Г.М. Электростанции и электрические сети. Диагностика и  контроль электрооборудования. М.: Додека., 2010 г.  6. Михалкова Е.Г. Эксплуатация электрических систем. Учебное пособие (для магистрантов высших учебных заведений специальности  «Электроэнергетика. – Алматы: АУЭС, 2016 – 97 с.  7. Короткевич М.А. Эксплуатация электрических сетей. Минск, 2005г.  8. Соколов С.Е. Эксплуатация и ремонт генераторов и распределительных устройств электрических станций. Алматы, АИЭС, 2005 г.  9. Соколов С.Е. Эксплуатация и ремонт воздушных и кабельных  линий Алматы, АИЭС, 2006 г.  10. https://drive.google.com/drive/folders/10vBmwGbMCuBgOIpdex8EcWBzdo  e-26QA?usp=sharing |

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| **Module name** | **MEE-M13-3 “Wave processes and overvoltages in electrical networks”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | Doct.Tech.Sci.,Professor Sokolov S. E. |
| **Language** | Russian |
| **Relation to curriculum** | Specialization **“Electricity Grid Systems”** |
| **Teaching methods** | Lectures, practical seminars, calculation and graphic work, independent work of the master under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; practical classes -30; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module**  **(Prerequisites)** | Scientific and technical problems of the electric power industry.  Main problems of operation of electric grids and systems |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES** to train undergraduates in the theory of occurrence and development of wave processes in electrical networks and systems and calculations of insulation of electrical equipment under the influence of overvoltages.  **LEARNING OUTCOMES:**  **Knowledge:**  **-** the basic requirements for calculating wave processes and  arising overvoltages;  - research methods, rules and conditions of work on the protection of electrical equipment insulation;  - methods for processing, analyzing and summarizing the results of wave processes research;  - computer programs for overvoltage modeling and overvoltage protection.  **Be able to:**  **-** Calculate and analyze the modes of operation of electrical systems in the wave process;  **-** use special computer programs when modeling wave processes and overvoltages in high-voltage electrical networks;  - Create the most efficient electrical network schemes in order to reduce the impact of wave processes and overvoltages.  **COMPETENCIES:**  - ability to apply normative documents in practice, to be guided by them when solving technical issues of overvoltage occurrence in electrical networks;  - ability to identify possible options for surge protection;  - Analyze and critically evaluate the modes of operation of insulating structures in high-voltage electrical networks during design, installation and operation |
| **Content** | Mastering the theory of the emergence and development of wave processes in electrical equipment, electrical networks and systems. Calculation and analysis of high-voltage insulating structures. Using the software "Computer High Voltage Laboratory" (CHVLaboratory) for calculations of external and internal overvoltages. |
| **Current control** | Calculated graphic work -3, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, laboratory base. |
| **Literature** | 1 Кадомская К.П. Перенапряжения в электрических сетях различного назначения и защита от них. – Новосибирск, Энергия,2006. – 350 с.  2 Расчет электрических полей устройств высокого напряжения. / под ред. Е.С.Колечицкого. – М.: МЭИ, 2008. – 248 с.  3 Ж.К. Оржанова. Волновые процессы в электрических сетях. Конспект лекций для научной магистратуры специальности 6М071800 – Электроэнергетика. – Алматы: АУЭС, 2018. – 93с.  4 Ж.К. Оржанова. Волновые процессы в электрических сетях. Методические указания и задания по выполнению расчетно-графических работ для научной магистратуры специальности 6М071800 – Электроэнергетика. – Алматы: АУЭС, 2018. – 15 с.  5 Оржанова Ж.К., Соколов С.Е. Волновые процессы и перенапряжения в электрических сетях. Конспект лекции для научно-педагогической магистратуры специальности 6М071800 – Электроэнергетика (специализация Электроэнергетические системы и сети). Алматы: АУЭС, 2013. |

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| **Module name** | **MEE-M14-3 “Special modes of long-distance power transmission”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | Associate Professor Genbach N. A. |
| **Language** | Russian |
| **Relation to curriculum** | **Compulsory / variable / specialization**  Specialization **“Electricity Grid Systems”** |
| **Teaching methods** | Lectures, practical seminars, calculation and graphic work, independent work of the master under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; practical classes -30; SSW – 99 (MSWS-15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module (Prerequisites)** | Scientific and technical problems of the electric power industry.  Main problems of operation of electric grids and systems |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVE:** To train master's students in the theoretical foundations of overhead power lines (OPL) operation and learn practical skills of their analysis and calculation  **LEARNING OUTCOMES:**  **Knowledge:**  **-** basic equations and ways of setting the initial data of overhead overhead lines;  - conditions of self-excitation of generators when they work on long overhead lines of UHV;  - methods for calculating modes of operation of UHV power lines;  - методы регулирования напряжения в электрических сетях.  **Be able to:**  **-** make substitution diagrams and determine their parameters for UHV power transmissions;  - to analyze and calculate the modes of operation of UHV power grids;  - Determine the capacity of power transmission lines;  - Increase the efficiency and reliability of UHV power grids.  **COMPETENCIES:**  - ability to apply normative documents in practice, to be guided by them when dealing with technical issues;  - ability to determine the benefits of power system interconnection;  - Analyze and critically evaluate normal and special modes of operation of UHV power lines;  - justify measures to increase the capacity of overhead transmission lines of the UHV |
| **Content** | Studying the issues of ultra-high voltage power transmission over long distances. Making a substitution diagram and determining the parameters of UHV electrical networks. Basic equations and ways of setting initial data. Analysis and calculations of normal and emergency modes. Increasing the capacity of UHV transmission lines.. |
| **Current control** | Calculated graphic work -3, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software. |
| Literature | 1. Рыжев Ю.П. Дальние электропередачи сверхвысокого напряжения: учебник для вузов- М.: Издательский дом МЭИ, 2007. -488с.  2. Передача и распределение электрической энергии: Учебное пособие/ А.А. Герасименко, В.Т.Федин В.Т. – Ростов - н/Д.: Феникс Красноярск: Издательские проекты, 2006. -720 с.  3. Передача электроэнергии на большие расстояния: Учебное пособие / С. С. Ананичева, П. И. Бартоломей, А. Л. Мызин; изд. 3-е, исправл. Екатеринбург: УрФУ, 2012-85с.  4. Савина Н.В Повышение пропускной способности электрических сетей: сборник учебно-методических материалов для направления подготовки 13.06.01. – Благовещенск: Амурский гос. ун-т, 2017  5. Проектирование линий электропередачи сверхвысокого напряжения /под ред. Г.Н. Александрова и Л.Л. Петерсона. – Л.: Энергоиздат, 1983.  6. Александров Г.Н. Новые средства передачи электроэнергии в энергосистемах. – Л.: Энергоатомиздат, 1987. |

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| **Module name** | **MEE-M15-3 “Tools and methods for ensuring the stability of electrical systems”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | Cand. Tech. Sci., Associate Professor K. K. Tokhtibakiev |
| **Language** | Kazakh, Russian |
| **Links to the curriculum** | **Compulsory / variable / specialization**  Specialization **“Electricity Grid Systems”** |
| **Teaching methods** | Lectures, practical seminars, calculation and graphic work, independent work of the master under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; -30; practical exercises - 15; SSW – 99 (MSWS -15)  **Contact hours for exam preparation:** 6 |
| **Credits** | 5 |
| **Required and recommended prerequisites for joining the module (Prerequisites)** | Scientific and technical problems of the electric power industry.  Main problems of operation of electric grids and systems |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  to develop knowledge of the means and methods of ensuring the stability of electrical systems, the principles of controlling the modes of their operation and the construction of emergency automatics.  **LEARNING OUTCOMES**  **Knowledge:**  - conditions and criteria for static and dynamic stability;  - methods for analyzing the stability of electrical systems;  - basic means and methods for ensuring the stability of electrical systems;  - structure and principles of operation of emergency control devices.  **Be able to:**  - analyze the stability of electrical systems;  - make calculation diagrams of electrical networks;  - perform calculations of normal and limiting modes using special programs;  - determine measures to improve the stability of electrical systems  **COMPETENCIES:**  - able to analyze the stability of electrical systems under normal and extreme conditions;  - Demonstrate knowledge in enhancing the stability of power systems under small and large disturbances;  - Analyze and critically evaluate the use of various means and methods of ensuring the stability of electrical systems;  - Use special software Dig Silent Power Factory and RTDS when calculating the stability of electrical systems. |
| **Content** | The main issues of theory and practical methods of calculations of stability of power systems and load units are considered. The main measures to improve stability are given and their classification is given. Additional means and devices of automatics for increasing stability are considered. Applicability of mathematical theory of stability in the electric power industry. The use of special software tools for calculating the stability of electrical systems. |
| **Current control** | Calculated graphic work -3, boundary control 2, tests |
| **Final control** | Exam |
| **Study and examination requirements** | Personal computer, software |
| **Literature** | 1. Калентионок Е.В. Устойчивость электроэнергетических систем.- Мн.: «Техноперспектива» 2008  2. Куликов Ю.А. Переходные процессы в электрических системах: Учеб. пособие для вузов/ М-во образ. РФ. Новосибирский ГТУ. – Новосибирск – Москва: НГТУ, Мир, АСТ, 2003.  3 Переходные процессы в элек.энергетических системах. под ред. И.П.Крючков и др.- М. «МЭИ» 2009  4. Переходные процессы электрических систем в примерах и иллюстрациях: Учеб. пособие. Под ред. В.А. Строева. – М.: 1996.  5. Веников В.А. Переходные электромеханические процессы в электрических системах. - М.: Высшая школа, 1978.  6. Тохтибакиев К.К., Оржанова Ж.К. Средства и способы обеспечения устойчивости энергосистем. Методические указания и задания к выполнению лабораторных работ для студентов специальности 050718 – Электроэнергетика. Алматы: АИЭС, 2009.  7. <https://books.google.kz/>  8. <http://engineeringsystems.ru/expluataciya-aes/sistemniye-avarii.php> |

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| **Module name** | **MEE-M21-3 “Scientific basis for the management of interconnected power systems”** |
| **Semester(s), in which the module is taught** | 3 |
| **Person, responsible for the module** | Cand. Tech. Sci., Associate Professor K. K. Tokhtibakiev |
| **Language** | Russian |
| **Relation to curriculum** | **Compulsory/variable /specialization**  Specialization **“Electricity Grid Systems”** |
| **Teaching methods** | Lectures, practical seminars, calculation and graphic work, independent work of undergraduates under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Contact hours:**  lectures -30; practical classes – 15; SSW – 99( MSWS -15)  **Contact hours for exam preparation:** 6 |
| **Credits** | 5 |
| **Required and recommended prerequisites for joining the module (Prerequisites)** | Scientific and technical problems of the electric power industry.  Основные проблемы эксплуатации электрических сетей и систем.  Means and methods of ensuring the stability of electrical systems. |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVE:** Formation of knowledge in the field of control theory of electric power systems modes, the concept of intelligent power grids, computer modeling of control processes in normal and emergency modes.  **LEARNING OUTCOMES**  **Knowledge:**  - methods for controlling the modes of electric power systems;  - conditions for the existence of stable regimes, criteria of static and dynamic stability;  - basic definitions and general characteristics of the transient process in emergency and post-emergency modes;  -the main types, means and methods of setting up emergency control.  **Be able to:**  - Analyze and determine the area of stable modes of electric power systems;  - make design diagrams of electrical networks;  - perform calculations of normal and limit modes using PSCAD and Dig Silent Power Factory programs;  - to adjust the emergency automatics.  **COMPETENCIES:**  - has a basic knowledge of the theory of electric power system mode control;  - able to analyze and assess the stability of power systems;  - simulate control processes of electric power systems in normal and emergency modes;  - perform calculations of electric power system modes using PSCAD and Dig Silent Power Factory programs. |
| **Content** | Studying the principles of open- and closed-loop systems control, the use of adaptive models in the control loop of electric power systems modes, the concept of intelligent power grids. To master knowledge in the field of control theory of electric power systems modes and mathematical modeling of control processes of electric power systems in normal and emergency modes. |
| **Current control** | Calculated graphic work -3, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, laboratory facilities. |
| **References** | 1. Тохтибакиев К.К. Адаптивное управление режимами электроэнергетических систем. Алматы: ТОО «Издательство LEM», 2017.-180 с.  2. Тохтибакиев К.К., Саухимов А.А. и др. Передовые технологии управления режимами энергосистем. Алматы: ТОО «Издательство LEM», 2017.- 152 с.  3. Куликов Ю.А. Переходные процессы в электрических системах: учеб.пособие для вузов/ М-во образ. РФ. Новосибирский ГТУ. – Новосибирск – Москва: НГТУ, Мир, АСТ, 2003.  4. Калентионок Е.В. Устойчивость электроэнергетических систем.-М.: «Техноперспектива», 2008  5. Переходные процессы в электроэнергетических системах/ под ред. И.П.Крючков и др.-М. «МЭИ», 2009  6. Герасименко А.А. Передача и распределение электрической энергии.-Ростов-на/Д , 2012  7. Татур Т.А. Установившиеся и переходные процессы в электрических цепях.-М.,2001  8. Калентионок Е.В. Оперативное управление в энергосистемах.-Мн: «Техноперспектива», 2007  9. Автоматическое управления и диспетчеризация электрических систем и энергообъединений. Метод. указание к выполнению РГР для магистрантов специальности 6М071800 – Электроэнергетика. Алматы 2010. АИЭС.  10. Научные основы автоматизации, управления и диспетчеризации энергообъединении. Метод. указание к выполнению РГР для магистрантов специальности 6М071800 – Электроэнергетика. Алматы 2010. АИЭС  11. Справочник по проектированию электрических сетей/под ред. Д.Файбисович.-М. «НЦ ЭНАС», 2006 |

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| **Module name** | **MEE-M13-4 “Relay protection of distribution networks and surge protection”** |
| **Semester(s), in which the module is taught** | **2** |
| **Person, responsible for the module** | Associate Professor, Cand.Tech.Sce., V. I. Dmitrichenko. |
| **Language** | Kazakh/Russian |
| **Relation to curriculum** | **Compulsory/variable /specialization**  **Specialization “Power supply and relay protection”** |
| **Методы обучения** | Lectures, laboratory work, practical classes, calculation and graphic work, independent bachelor's work under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 210 hours  **Class hours:**  lectures -30; laboratory work -15; practical classes – 15; SSW – 99 (MSWS-10) **Examination preparation hours:** 6 |
| **Credits** | **7** |
| **Required and recommended pre-requisites for joining the module (Prerequisites)** | «Theoretical foundations of electrical engineering», «Relay protection of electric power systems», “Fundamentals of microprocessor technology» |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  to acquaint undergraduates with relay protection systems of distribution electric networks and overvoltage limitation in power grids of industrial enterprises and cities.  **LEARNING OUTCOMES::**  **Knowledge::**  -theoretical foundations of the occurrence of overvoltages in power grids;  - physical basis of compensation of capacitive currents;  - relay protection systems for distribution power grids and surge limitation, algorithms for relay protection against earth faults;  - relay protection equipment, devices and systems and overvoltage restrictions applied in practice.  **Be able to:**- calculate the values of capacitive currents and determine the current distribution during earth faults in power grids;  - calculate setpoints and select relay protections against ground faults;  - calculate parameters and select electrical equipment to limit overvoltage.  **COMPETENCIES:**  - knowledge of methods of research of power supply facilities of industrial enterprises and cities and the development of projects for relay protection of distribution electrical networks and limitation of overvoltage;  - knowledge of the basic techniques of commissioning and maintenance of relay protection devices, electrical automation, remote control and alarm systems, work with acceptance documentation.  - measures for the correct and optimal operation of electrical equipment;  - practical application of regulatory documents, to be guided by them in solving scientific and technical issues. |
|  | The discipline examines the basics of relay protection against earth faults: neutral modes of 6-35 kV power grids, the physical basis of compensation of capacitive currents, general principles of protection, features of current distribution during earth faults, relay protection algorithms, equipment, devices and protection systems used in practice. Information is provided on overvoltages arising in networks, which in most cases are the root cause of ground faults: sources and types of overvoltages, methods and electrical equipment for their limitation. |
| **Current control** | Laboratory work 4, calculation and graphic work 3, boundary control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, laboratory facilities. |

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| **Module name** | **MEE-M14-4 “Anti-emergency operational and automatic control of electric power systems”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | Associate Professor Bashkirov M. V. |
| **Language** | Russian |
| **Relation to curriculum** | **Compulsory/variable /specialization**  **Specialization “Power supply and relay protection”** |
| **Teaching methods** | Lectures, practical seminars, laboratory work, coursework, Bachelor's independent work under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Total workload:** 150 hours  **Contact hours:**  Lectures -30; practice -15; SSW – 99 (MSWS -15)  **Contact hours for exam preparation:** 6 |
| **Credits** | 4 |
| **Required and recommended prerequisites for joining the module (Prerequisites)** | Computer network technology in the electric power industry;  Electrical networks and systems;  Microprocessor relays and modern high voltage grid protection systems» |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVE:** to master the knowledge of the properties and characteristics of system automation in emergency modes. To study general patterns of transmission, processing of information in the systems of operational and emergency control, as well as algorithms and schemes of the main devices of emergency automatics..  **LEARNING OUTCOMES:**  **Knowledge:**  Algorithms and schemes of the main devices of emergency automatics.  - automatic reclosure; frequency overload automatics  - frequency overload automatics;  - power boost automatics;  - Automatics of asynchronous mode elimination;  **Be able to:**  - calculate settings of frequency overload automatics;  - frequency overload automatics  - Parameterize digital PA devices;  **COMPETENCIES:**  - apply normative documents in practice, be guided by them when solving technical problems of production;  - Organize and carry out maintenance of complex emergency automation devices, measuring instruments and alarm systems |
| **Content** | The paper outlines the fundamentals of emergency control (AC) automation, designed to reduce damage to the power system and its consumers from large emergency perturbations and especially to counteract the territorial spread of a catastrophic emergency process, accompanied by high rate of change of power system mode parameters, in which automatic and operational control systems of normal modes are ineffective  The main types of emergency automatics are studied: devices of automatic prevention of disturbance of stability of parallel operation; |
| **Current control** | Calculated and graphic works 1, milestone check 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software, laboratory base. |
| **References** | 1. Александров В. Ф., Езерский В.Г., Захаров О. Г., Малышев В.С.Частотная разгрузка в энергосистемах. Ч1, Ч2. М.: НТФ «Энергопрогресс», 2007.  2. Овчаренко Н. И. Автоматика электрических станций и электроэнергетических систем: Учебник для вузов /Под ред. А. Ф. Дьякова. -М.: Изд-во НЦ ЭНАС, 2000.  3. Башкиров М. В. Противоаварийное оперативное и автоматическое управление электроэнергетических систем. Методические указания и задания к выполнению расчетно-графической работы№1 и №2 для магистрантов всех форм обучения специальности 6М071800 – Электроэнергетика. – Алматы: АУЭС, 2010.  4. Башкиров М.В. Противоаварийное оперативное и автоматическое управление электроэнергетических систем. Конспект лекций для магистрантов по образовательной программе - 7М071 – Электроэнергетика. – Алматы: АУЭС, 2021.  5. <https://rza.org.ua/down/view/Osnovi-releynoy-zashchiti_11.html>  6. <https://pro-rza.ru/> |

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| **Module name** | **MEE-M8-4 “Computer-aided design of low and medium voltage electrical networks”** |
| **Semester(s) in which the module is taught** | 1 |
| **The person responsible for the module** | Academic Associate Professor, Cand.Tech.Sci., K. A. Bakenov. |
| **Language** | Russian |
| **Links to the curriculum** | **Compulsory / variable / specialization**  Specialization **”Power supply and relay protection”** |
| **Teaching methods** | Lectures, laboratory work, three calculation and graphic work, Independent work of the magistrate under the guidance of the teacher |
| **Workload (including contact hours, self-study hours)** | **Total workload:** 150 hours  **Contact Hours:**  Lectures -15; laboratory work -30; SSW – 99 (MSWS -15)  **Contact hours for exam preparation:** 6 |
| **Credit scores** | 5 |
| **Necessary and recommended prerequisites for joining the module (Prerequisites)** | 1) Theory of modeling and scientific experiment or Fundamentals of Modeling and Data Processing of Scientific and Engineering Experiments;  2) Scientific and technical problems of the electric power industry.  Knowledge gained in the study of special undergraduate disciplines. |
| **Module objectives/expected learning outcomes** | **MODULE OBJECTIVES:** to master the knowledge of the properties and characteristics of system automation in emergency modes. To study general patterns of transmission, processing of information in the systems of operational and emergency control, as well as algorithms and schemes of the main devices of emergency automation.  **LEARNING OUTCOMES:**  **The masters know:**  - main sources of technical information on the materials of SNiP, SanPiN and GOST in the power supply;  - the principles of building modern intelligent CAD systems;  - methods of system analysis of complex objects;  - the technology of the traditional design process;  - concepts, principles, and structural implementation of computer-aided design systems;  - Methods of building mathematical models and their application in CAD;  **know how:**  - search and analyze scientific and technical information and select the necessary information materials;  - carry out calculations according to standard methods and be able to design using standard design automation tools in accordance with the terms of reference;  - participate in the development of design and working technical documentation, registration of completed design and development work in accordance with standards, specifications and other regulatory documents;  - independently understand normative methods of calculation and apply them to the solution of the task.  **competence:**  - ability to design new medium and low voltage electrical network facilities. |
| **Content** | Изучает организацию расчетов в сетях среднего и низкого напряжения с использованием компьютерных программ по распределению нагрузок, выбору электротехнического оборудования, определения ТКЗ, выбору параметров защитных элементов, компенсации реактивной мощности. Используя современные технические и программные средства, внедряя новые технологии в проектировании, проводится обучение основам автоматизированного проектирования электрических сетей низкого и среднего напряжения с использованием про-граммного комплекса Moeller. |
| **Form of current control** | Calculated graphic work 3, boundary control 2, tests |
| **Form of final control** | Examination |
| **Requirements for studies and exams** | Personal computer, software, laboratory base. |
| **Literature** | **Primary literature**  1. Кудрин Б.И. Электроснабжение промышленных предприятий: Учебник  для студентов высших учебных заведений. – М.: Интермет Инжиниринг, 2005, 2006, 2008.  2. Акимов Е.Г. Выбор, проектирование и монтаж электроустановок зданий.-М.: СмарБук, 2009.  3. Система автоматизированного проектирования электрических сетей 0.4-10 кВ. http://www.sapr04.com.ua/  4. Киреева Э.А. и др. Электроснабжение и оборудование цехов промышленных предприятий. – М.: «Кронус», 2011, 2013.  5. Правила устройства электроустановок республики Казахстан. Союз инженеров-энергетиков. - Астана, 2014.  6. Ефимова О.Н. Автоматизированное проектирование электрических сетей низкого и среднего напряжения. Конспект лекций для магистрантов специальности 6М071800 – Электроэнергетика.- АУЭС, 2011.  7. Ефимова О.Н. Автоматизированное проектирование электрических сетей низкого и среднего напряжения. Методические указания и задания к курсовой работе для магистрантов специальности 6М071800 –Электроэнергетика. – АУЭС, 2011.  **Additional:**  8. Система программ xSpider версия 2.14, Справочное руководство. – Moeller, 2016  9. Сибикин Ю.Д. Электроснабжение промышленных предприятий и установок: Учебник для проф. учебных заведений. – М.: Высшая школа, 2001.  10. Аветисян Д.А. Автоматизация проектирования электротехнических систем и устройств. - М.: «Высшая школа», 2005 – 512с.  11. Киреева Э.А. и др. Электроснабжение цехов промышленных предприятий. – М.: НТФ Энергопрогресс, Энергетик, 2003.  12. Киреева Э.А. Справочные материалы по электрооборудованию (цеховые электрические сети, электрические сети жилых и общественных зданий), 2004 |

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| **Module name** | **MEE-M15-4 “Modern problems of power supply to cities and industrial enterprises”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | K.T. Tergemes, Ph.D., professor |
| **Language** | Russian |
| **Links to the curriculum** | **Compulsory / variable / specialization**  Specialization **“Power supply and relay protection”** |
| **Teaching methods** | Lectures, practical classes, coursework, independent work of a master's student under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Total workload:** 150 hours  **Contact hours:**  Lectures - 30; practical exercises -15; SSW – 99 (MSWS -15)  **Contact hours for exam preparation:** 6 |
| **Credit points** | 5 |
| **Required and recommended prerequisites for joining the module (Prerequisites)** | Main Problems of Operation of Electric Networks and Systems, Basics of Modeling and Data Processing of Scientific and Engineering Experiments, Theory of Modeling and Scientific Experiments, Solar Electricity and Geothermal Electricity, Energy Saving by Automated Electric Drive, Main Problems of Operation of Electric Networks and Systems. |
| **Module objectives/intended learning outcomes** | **PURPOSE OF THE MODULE:** to acquaint undergraduates with the methods and technology of calculating power supply to residential, public buildings and industrial enterprises, taking into account the modern development of the electric power industry.  **LEARNING OUTCOMES:**  The masters know:  - Current problems of power supply to major groups of consumers in cities;  - the main provisions, principles of construction and features of urban power supply systems;  - basic requirements for power quality and types of protection in the power supply system of residential and public buildings in cities;  **know how:**  - use information technology and regulatory documents in the field of urban power supply design;  - Analyze, develop, implement, and evaluate the effectiveness of energy- and resource-saving measures in the design of power supply systems for various city facilities;  **RJVGTNTWBB:**  - ability to effectively use modern computer and information technology, digital techniques and software in engineering and technical calculations in the design of power supply systems for various urban facilities;  - ability to demonstrate theoretical and practical knowledge in improving the reliability of urban electricity supply;  - ability to adapt new energy-saving technologies at various city facilities. |
| **Content** | The discipline aims to study the problems of efficient and reliable power supply in the sphere of housing and communal sector, administrative buildings, sports and industrial facilities of cities and ways to solve them. The discipline also introduces the use of modern energy-saving technologies and the latest equipment in the energy sector of cities. |
| **Current control** | Coursework, midterm check - 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software. |
| **References** | 1. Конюхова Е.А. Электроснабжение объектов. – М.: ИЦ «Академия», 2012.  2. Куско А. Системы электроснабжения. - М.: «Додэка», 2010.  3. Киреева Э. А., Цырук С.А. Электроснабжение жилых и общественных зданий. – М.: Энергопрогресс, 2005.  4. Правила устройства электроустановок. – М.: Энергия, 2003.  5. Сибикин Ю.Д. Электроснабжение промышленных и гражданских зданий. - М.: «Академия», 2007.  6. Анчарова, Т.В. Электроснабжение и электрооборудование зданий и сооружений. - М.: ФОРУМ, 2012.- 416с.  7. Казанина И.В. Современные проблемы электроснабжения городов и промышленных предприятий. Конспект лекций для магистрантов всех форм обучения специальности 6М0718 – Электроэнергетика. – Алматы: АУЭС, 2011. |

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| **Module name** | **MEE-M21-4 “Energy saving in industry”** |
| **Semester(s), in which the module is taught** | 3 |
| **Person, responsible for the module** | K.T. Tergemes, Ph.D., professor AUES |
| **Language** | Kazakh, Russian |
| **Relation to curriculum** | **Compulsory/variable/specialization**  Specialization **“Power supply and relay protection”** |
| **Teaching methods** | Lectures, practical seminars, independent work of the master under the guidance of a teacher |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Contact hours:**  lectures - 30; practice -15; SSW – 105 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | «Theoretical Foundations of Electrical Engineering», «Use of Renewable Energy Sources», «Alternative Energy and Energy Saving Technologies», «Theory of Simulation and Scientific Experiment» |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  studying the legal and regulatory framework of energy saving, the main directions of the state energy saving policy, the basics of the wholesale and retail electricity markets, the principles of rational use of energy resources in power supply systems of industrial enterprises, the organization of commercial accounting of electricity at industrial enterprises in networks with voltage up to and above 1 kV  **LEARNING OUTCOMES:**  **The masters know:**  - the basic requirements of the regulatory and legal documentation used in energy-saving systems;  - Principles of electricity pricing;  - Normal and maximum allowable voltage deviation values;  **know how:**  - conduct energy audits;  - registration of the results of energy surveys;  - justification for financing energy audits.  **COMPETENCIES:**  - justify and draw up energy balances of industrial and energy enterprises;  - Organize electricity metering at industrial enterprises;  - estimate the total energy input required for production. |
| **Contents** | Training a specialist capable of performing the full range of tasks related to energy conservation issues in industries and the housing and utilities sector, able to estimate the cost of electrical energy, to draw up energy-saving technologies. |
| **Current control** | Calculated and graphic works 3, milestone check 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Personal computer, software. |
| **Литература** | 1. Энергосбережение на промышленных предприятиях: учебное пособие / Г.Н. Климова., Издательство Томского политехнического университета, 2008.-186 стр. 2. Литвак В. В., Маркман Г. З., Харлов Н. Н. Электроэнергия: экономия, качество. Учебное пособие. – Томск: STT, 2001. – 196 с. 3. Писарук Т.В. Энергосбережение на промышленных предприятиях: Учебно-методическое пособие. — Минск: Белорусский национальный технический университет, 2019. — 107 с. 4. Булатов И.С., Пинч – технология. Энергосбережения в промышленности – СПб.: Страта, 2012.-140с. 5. Сушков В.В., Велиев М.К. и др. Экономия электроэнергии и снижение потерь в электротехнических комплексах нефтегазодобычи: Нижневартовск: Нижневартовский государственный университет, 2015. — 219 с. |

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| **Module name** | **МEE-М09**  **“Theory and Practice of Project Management”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | M.B. Aliyarova, Cand.Tech..Sci., certified project manager (№СРМ 00059) |
| **Language** | Kaz/Rus/Eng |
| **Relation to curriculum** | **Compulsory** |
| **Teaching methods** | lecture, practical classes, Master’s self- study work under a teacher supervision (MSWS), project, presentation, seminar. |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -30; practical classes -15; SSW – 99 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Economics and management of the industry, organization of production, entrepreneurial activity, enterprise management, organization of production |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  To form in undergraduates a set of theoretical knowledge and practical skills related to understanding the role of the project in the organization, the main provisions of the modern concept of project management, project management techniques using modern tools and methods.  **LEARNING OUTCOMES:**  **Knowledge:** to know how to use the tools, methods, templates of project documents in project management;  to know international standards in the field of project management; be able to determine the scope of project management standards; to know modern terminology, concepts, tools and methods applied to project management;  **Be able to** analyze the goals and interests of project stakeholders; determine the goals, objectives, organizational structure of the project and the hierarchical structure of work; calculate the time and cost of the project.   * **Skills:** to have the skills of organizing communication and interaction of stakeholders of the project, teamwork; decision-making tools based on the assessment of external factors among and assets of the organization's processes; the technique of independent management of simple projects and effective participation in the work of a complex project management team. |
| **Content** | Upon completion of the course, undergraduates will be able to form an optimal set of processes and procedures for project management, in relation to a particular organization, taking into account its specifics, marketplace, development strategy, which in turn will lead to an increase in the efficiency of project management and, as a result, an increase in its competitiveness. |
| **Current control** | Presentation on the project by a group of developers, mid-term control – computer testing |
| **Final control** | Examination in test form |
| **Study and examination requirements** | Timely and complete performance of all types of work (practical, independent). – Do not be late and do not miss classes, be punctual and obligatory. There is a 10% reduction in the maximum score for late submissions. - If the undergraduate is forced to miss the boundary control or exam for good reasons, he must inform the teacher in advance. – in order to prepare for the defense of practical tasks and midterm control a master student must participate in a team formed from a study group |
| **References** | 1. Свод знаний по управлению проектами: Project Management Institute, 6 2017.  2. Agile Practice Guide / Project management Institute. 2017.  3. СТ РК ISO 21500-2014 Руководство по управлению проектами / Комитет технического регулирования и метрологии Министерства индустрии и новых технологий Республики Казахстан. 2014  4. СТ РК 2831-2016 Требования к управлению проектами / Комитет технического регулирования и метрологии Министерства индустрии и новых технологий Республики Казахстан. 2016  5. Основы индивидуальный компетенций для управления проектами, программами и портфелем. Том 1. / под ред. К.А.Сагадиева, Казахстанская ассоциация управления проектами, 2018 г.  6. Управление проектами: практика предприятий ОПК РК: учебное пособие / под ред. А.Ф. Цехового. – Нур-Султан, «Кazakhstan Partners». 2019. с.  7. Руководство SCRUM 8.Управление проектами и программами. Ершов С.В. Управление проектами и программами. Конспект лекций. – Архангельск: САФУ. 2015 – 226 с.  8.Казакова Е.И. Разработка и принятие управленческих решений. Учебнометодическое пособие. – СПб.: Отдел оперативной полиграфии НИУ ВШЭ — СанктПетербург, 2011. – 122 с. |

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| **Module name** | **MEE-M11/22 "Research Practice"** |
| **Semester(s) in which the module is taught** | 2 and 4 |
| **Person responsible for the module** | R.M. Nigmatullin, Associate Professor, Cand.tech.Sci. |
| **Language** | Russian |
| **Relation to curriculum** | **Compulsory** |
| **Teaching methods** | research and experimental studies in production and in laboratories of AUPET (specialized TSRL) |
| **Working hours (incl. class hours, self-study hours)** | **Total working hours:** 120 hours (2 term), 210 hours (4 term)  **Class hours:**  Practice - 60; laboratory classes – (60+210) |
| **Credits** | 4 (2 term), 7 (4 term) |
| **Required and recommended prerequisites for joining the module** | Since the content of research practice is determined by the topic of the dissertation research, the undergraduate must first study the literary and patent sources on the topic being developed to use them when performing qualifying work at the enterprise as well as issues of labor protection and life safety. |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  acquaintance with the latest theoretical, methodological, and technological achievements of domestic and foreign science, with modern methods of scientific research, processing, and interpretation of experimental data.  **LEARNING OUTCOMES:**  **Demonstrate** the ability to use in practice the skills of organizing research and development work, the ability and willingness to apply modern research methods, conduct technical tests and (or) scientific experiments, evaluate the results of the work performed.  **Use** in-depth theoretical and practical knowledge that is at the forefront of science and technology in the field of professional activity. |
| **Content** | The content of research practice is determined by the topic of the dissertation research. Research practice systematizes, expands, and consolidates professional knowledge, forms the undergraduate's skills of conducting independent scientific work, research, and experimentation. |
| **Current control** | Monitoring of the practice tasks implementation according to the practice Diary by the head of practice from the university. |
| **Final control** | Defense of the practice report before the commission |
| **Study and examination requirements** | **Facilities for successful module implementation**:  Laboratory equipment, preparing a presentation to defend the report |
| **References** | 1. Специальная литература по теме диссертационного исследования   2. Хан С.Г. Методические указания по организации и проведению профессиональной практики по группе образовательных программ послевузовского образования «Автоматизация и управление» для магистрантов ОП «Автоматизация и управление». – Алматы: АУЭС, 2020. – с. 20. |

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| **Module name** | **MEE-M16 "Pedagogical practice"** |
| **Semester(s) in which the module is taught** | 3 |
| **Person responsible for the module** | R.M. Nigmatullin, Associate Professor, Cand.Tech.Sci. |
| **Language** | Russian |
| **Relation to curriculum** | **Compulsory** |
| **Working hours (incl. class hours, self-study hours)** | **Total working hours:** 120 hours  **Class hours:**  Practice - 120 |
| **Credits** | 4 |
| **Required and recommended prerequisites for joining the module** | Pedagogy of higher education, Foreign language (professional) |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  consolidation and deepening of knowledge in general scientific, cultural, psychological, and pedagogical, methodological, and special disciplines, as well as pedagogical skills and competencies formation based on theoretical knowledge.  **LEARNING OUTCOMES:**  **Demonstrate** the ability to independently acquire and use new knowledge and skills in practice, including knowledge in new areas that are not directly related to the field of activity, expand and deepen scientific outlook, including modern information technologies, the ability to analyze, synthesize and critically summarize information.  **Use** in-depth theoretical and practical knowledge that is at the forefront of science and technology in the field of professional activity.  **Demonstrate** readiness for pedagogical activity in the field of vocational training. |
| **Content** | Study of the state educational standard and modular (MC) curriculum for the of EPS, ESRES and EMED; educational and methodical literature, hardware, and software of laboratory workshops on one selected discipline of the curriculum; organizational forms and teaching methods at a higher educational institution.  Conducting students practical and laboratory classes on the recommended topics of academic disciplines; conducting trial lectures in student classrooms under the teacher’s supervision. |
| **Current control** | Monitoring of the practice tasks implementation according to the practice Diary by the head of practice from the university. |
| **Final control** | Practice report defense before the commission |
| **Study and examination requirements** | **Facilities for successful module implementation**:  Study of regulatory documents; laboratory equipment of curriculum for the of EPS, ESRES and EMED department laboratories; presentation preparing to defend the practice report. |
| **References** | 1. Нормативные документы по высшему и послевузовскому образованию.   2. Хан С.Г. Методические указания по организации и проведению профессиональной практики по группе образовательных программ послевузовского образования «Автоматизация и управление» для магистрантов ОП «Автоматизация и управление». – Алматы: АУЭС, 2020. – с. 20. |