



Module Handbook

for the degree program

AUTOMATION and CONTROL

(Direction: Master's studies scientific and pedagogical)



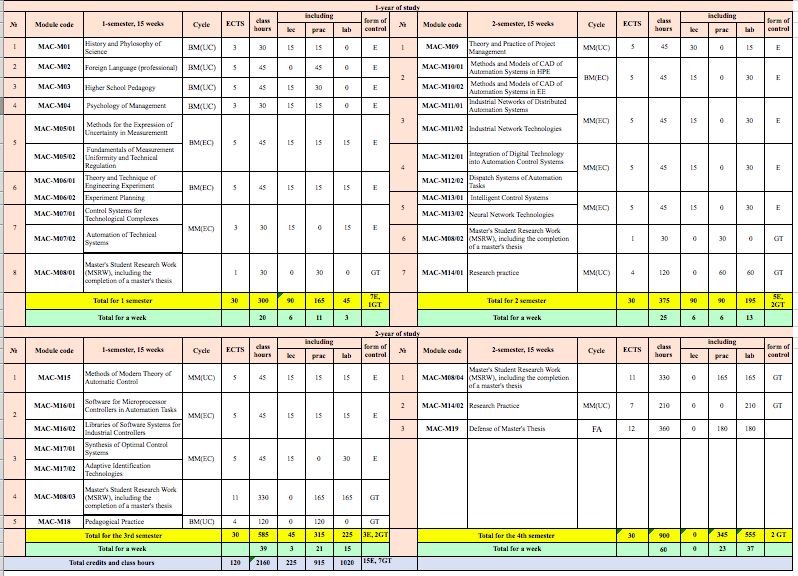
Almaty, 2020-2022

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Curriculum of postgraduate studies

7М07105 - Automation and Control



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| **Module name** | **MAC-M01 "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** | **МАC-М02 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** | **МАC-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** | **МАC-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** | **MAC-M05/01 "Methods for the Expression of Uncertainty in Measurements"** |
| **Semester(s) in which the module is taught** | 1 |
| **Person responsible for the module** | Professor, Cand tech sc. Khan Svetlana Gurievna |
| **Language** | Russian |
| **Relation to curriculum** | Elective with "Fundamentals of Measurements Uniformity and Technical Regulation" |
| **Teaching methods** | lecture, practical seminars, laboratory work, course project, Master’s self-study work under teacher’s supervision (MSWS) |
| **Working hours (incl. class hours, self-study hours)** | Total working hours: 150 hours  Class hours:  Lectures-15; Practical classes – 15; Laboratory classes - 15; SSW – 99 (MSWS -15)  Examination preparation hours: 6 |
| **Credits** | 5 |
| **Required and recommended prerequisites for joining the module** | Linear Automatic Control Systems; Nonlinear Automatic Control Systems;  Higher mathematics (probability theory) |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES:**  undergraduates' knowledge formation in the field of estimating the uncertainty of measurement results, which will allow the young specialist to further improve and independently make decisions to improve the quality of measurements, as well as acquire skills in applying the methods and practical foundations of the course when calculating errors and uncertainty of measurement results and measuring instruments.  **LEARNING OUTCOMES:**  Knowledge: fundamentals of legal metrology and technical regulation; methods of practical organization and performance of work on technical regulation; measurement results processing methods; methods for estimating the uncertainty of measurement results.  Skills: Be able to competently carry out measurements, calibrate measuring instruments and calculate the measurement uncertainty; correctly process single and multiple measurements.  Competences: apply normative documents in practice, be guided by them when solving technical issues of production; make a decision based on the results of calibration of measuring instruments with the calculation of measurement uncertainty. |
| **Content** | The discipline introduces undergraduates to the basics of legal metrology, the basics of technical regulation, the State system for ensuring the uniformity of measurements; as well as with international recommendations for estimating the uncertainty of measurement results, methods for calculating measurement uncertainty and their application in the calibration of measuring instruments. |
| **Current control** | Course project, Midterm control 1, Midterm control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Facilities for successful module implementation:  PC, Software LabView. |
| **References** | 1. JCGM 101:2008 Evaluation of measurement data—Supplement 1 to the “Guide to the expression of uncertainty in measurement”—Propagation of distributions using a Monte Carlo method. Joint Committee for Guides in Metrology 2. EURACHEM/CITAC Guide CG4. Quantifying uncertainty in analytical measurement. 2012. 3. ГОСТ Р 54500.1-2011. Неопределенность измерения. Часть 1. Введение в руководство по неопределенности измерения 4. ГОСТ 34100.3-2017. Неопределенность измерения. Часть 3. Руководство по выражению неопределенности измерения 5. СТ РК ИСО 21748-2010. Руководство по использованию оценок повторяемости, воспроизводимости и точности при оценивании неопределенности измерений 6. Степанов Е.А. и др. Основы обработки результатов измерений. Учебное пособие, 2014.   Хан С.Г. Метрология, измерения и техническое регулирование. Учебное пособие, 2009. |

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| **Module name** | **MAC-M05/02 "Fundamentals of Measurements Uniformity and Technical Regulation"** |
| **Semester(s) in which the module is taught** | 1 |
| **Person responsible for the module** | Professor, Cand tech sc. Khan Svetlana Gurievna |
| **Language** | Russian |
| **Relation to curriculum** | **Elective**  with "Methods for the Expression of Uncertainty in Measurements" |
| **Teaching methods** | lecture, practical seminars, laboratory work, course project, Master’s self-study work under teacher’s supervision (MSWS) |
| **Working hours (incl. class hours, self-study hours)** | **Total working hours:** 150 hours  **Class hours:**  Lectures-15; Practical classes -15; Laboratory classes - 15; SSW – 99 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended prerequisites for joining the module** | Linear Automatic Control Systems; Nonlinear Automatic Control Systems;  Higher Mathematics (probability theory) |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  undergraduates' minimum knowledge formation in the field of technical regulation, which allows a young specialist further improvement, make technical decisions independently at the international, regional and national levels, as well as the skills development to apply methods and practical foundations of the course when choosing equipment and instruments, calculating the errors of measuring instruments, total errors of measuring channels, development of standards and calculation of their effectiveness.  **LEARNING OUTCOMES:**  **Knowledge:** of technical regulation fundamentals; methods of practical organization and performance of work on technical regulation; classification of measurements types and methods; basic metrological characteristics of measuring instruments; classification of measurement errors and measuring instruments; measurement results processing methods;  **Be able:** to competently carry out measurements, calibrate measuring instruments and calculate measurement errors; correctly process single and multiple measurements.  **Competences:** to apply the standards in practice: GSI, GSS, ESPD, ESKD and other regulatory documents, be guided by them when solving technical issues of production**.**  **To form** a solution based on the results of calibration of measuring instruments and calculate measurement errors. |
| **Content** | The discipline will familiarize undergraduates with the measurements theory, the main methods of measurements, the theory of errors and methods for calculating errors of measurements and measuring instruments, as well as technical regulation basics, the State system for ensuring the uniformity of measurements. |
| **Current control** | Course project, Midterm control 1, Midterm control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | **Facilities for successful module implementation**:  PC, Software LabView, National Instruments Laboratory equipment. |
| **References** | 1. Сергеев А.Г. Метрология, стандартизация и сертификация. – М., 2012. 2. Степанов Е.А. и др. Основы обработки результатов измерений. Учебное пособие, 2014. 3. Хан С.Г. Основы единства измерений и техническое регулирование. Учебное пособие –Алматы: АУЭС, 2015.   4. Хан С.Г. Основы единства измерений и техническое регулирование. Конспект лекций (для магистрантов специальности 6М070200 – Автоматизация и управление). –Алматы: АУЭС, 2011. |

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| **Module name** | **МАC-М06/01 «Theory and Technique of Engineering Experiment»** |
| **Semester(s), in which the module is taught** | 1 |
| **Person, responsible for the module** | Professor, c.t.s. Lida Ibrayeva |
| **Language** | Russian |
| **Relation to curriculum** | **Elective**  with “Experiment Planning” |
| **Teaching methods** | lecture, practical seminars, laboratory works, calculation graphic works, 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 -15; laboratory classes - 15; SSW – 99 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Linear Automatic Control Systems; Non-linear Automatic Control Systems; Higher mathematics |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  to study the theory and technology of the main tasks of experimental research of control objects, including the issues of choosing a test methodology, developing algorithmic and software tools for processing the results of experimental tests by methods of correlation and regression analysis  **LEARNING OUTCOMES:**  **Knowledge:** to understand the theory and formulation of the main tasks of experimental studies of complex control objects;  **Be able to** process the results by methods of correlation and regression analysis.  **To Form solutions** for the construction and study of mathematical models of control objects;  **To have an experience** in planning experimental research in the field of engineering experiment technology; using the possibility of modern computers and information technologies in computer modeling of optimal processes of observation and evaluation. |
| **Content** | Features of complex control objects. Significance criteria. Hypothesis testing procedures. Principles of building regression models of complex objects. Basic concepts of the theory of planning experiments. Full factorial experiment. Property of orthogonality of the PFE plan. Fractional factorial experiment. Optimization problem in extreme experiments. |
| **Current control** | Calculation graphic works, mid-term test 1, mid-term test 2, Tests |
| **Final control** | Examination |
| **Study and examination requirements** | **Facilities for successful module implementation:**  Personal computer, software. |
| **References** | 1. Сидняев Н.И. Теория планирования эксперимента и анализ статистических данных. - 2011 2. Адамбаев М. Д. Теория и практика технического эксперимента в электроэнергетике. - 2013 3. Ибраева Л.К. Теория и техника инженерного эксперимента. Конспект лекций для магистрантов научного направления спец. 6М070200 – АУ: АУЭС, 2015.   4. Ибраева Л.К. Теория и техника инженерного эксперимента. Методические указания к выполнению лабораторных работ для магистрантов научно-педагогической магистратуры спец. 5В070200 – АУ: АУЭС, 2017. |

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| **Module name** | **МАC-М06/02 “Experiment Planning”** |
| **Semester(s), in which the module is taught** | 1 |
| **Person, responsible for the module** | Professor, c.t.s. Lida Ibrayeva |
| **Language** | Kazakh, Russian |
| **Relation to curriculum** | **Elective**  with Theory and Technique of Engineering Experiment” |
| **Teaching methods** | lecture, practical seminars, laboratory works, calculation graphic work, 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 -15; laboratory classes - 15; SSW – 99 (MSTS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Linear Automatic Control Systems; Nonlinear Automatic Control Systems; Higher Mathematics |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  to study the theory and technology of the main tasks of control objects experimental research, including the issues of choosing a test methodology, developing algorithmic and software tools for processing the results of experimental tests by methods of correlation and regression analysis.  **LEARNING OUTCOMES:**  **Knowledge:** to understanding the theory of planning experiments for the study of complex control objects; methods for identifying the parameters of regression models of control objects.  **Skills: be able to** plan experiments in accordance with the chosen optimization criterion and the type of response function; to carry out statistical processing of experimental results by methods of correlation and regression analysis. **To apply** methods of statistical analysis for assessing the quality of the developed model.  **Competences:** to have an experience in planning experimental research; application of experiment planning methods for the development of experimental models of control objects. |
| **Content** | Means and methods of measurements in experimental studies. Statistical procedures. Fundamentals of experiment planning. General requirements for the experiment plan. Criteria for the optimality of plans. Mathematical modeling in experimental research. Dispersion analysis. Features of multivariate analysis of variance. Planning an experiment in the search for optimal conditions. Second-order planning in the study of the optimum region. |
| **Current control** | Calculation graphic work, mid-term test 1, mid-term test 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | **Facilities for successful module implementation:**  Personal computer, software. |
| **References** | 1. Сидняев Н.И. Теория планирования эксперимента и анализ статистических данных. - 2011 2. Адамбаев М. Д. Теория и практика технического эксперимента в электроэнергетике. - 2013 3. Ибраева Л.К. Теория и техника инженерного эксперимента. Конспект лекций для магистрантов научного направления спец. 6М070200 – АУ: АУЭС, 2015.   4 Ибраева Л.К. Теория и техника инженерного эксперимента. Методические указания к выполнению лабораторных работ для магистрантов научно-педагогической магистратуры спец. 5В070200 – АУ: АУЭС, 2017. |

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| **Module name** | **МАC-М07/01 “Control Systems for Technological Complexes”** |
| **Semester(s), in which the module is taught** | 1 |
| **Person, responsible for the module** | Professor c.t.s. Bakhyt Mukhanov |
| **Language** | Russian |
| **Relation to curriculum** | **Elective**  with “Automation of Technical Systems” |
| **Teaching methods** | lecture, laboratory works, calculation graphic work, 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; lab classes -15; SSW – 54 (MSWS -5)  **Examination preparation hours:** 6 |
| **Credits** | 3 |
| **Required and recommended pre-requisites for joining the module** | Linear Automatic Control Systems; Non-linear Automatic Control Systems. |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  to studythe basic principles of mathematical modeling and computer-aided design of systems and automation tools used in the heat power engineering complex, consolidating the skills of developing and researching their models.  **LEARNING OUTCOMES:**  **Knowledge:** to know the basics of describing control systems and means; bases of decomposition of organizational and technical control systems; methods for studying systems with typical controllers  **Ability:** be able to apply the methods of representing the considered control system in the form of a type and typical structures; evaluate the stability of systems with standard controllers.  **Skills:** to have skills in determining the optimal settings for typical controllers for automation objects.  **Competences:** toform the tasks of designing tools and control systems with selected quality criteria; development of automation systems for various technological facilities. |
| **Content** | Fundamentals of building automatic control systems. Decomposition of control systems. Description of the type and typical structures and their mathematical content, the principles of their interrelationships and compatibility. Definition and classification of means of control systems. Study of calculation methods according to selected criteria. Design of microprocessor means. |
| **Current control** | Calculation graphic work, mid-term test 1, mid-term test 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | **Facilities for successful module implementation:**  Laboratory equipment, personal computer, software. |
| **References** | 1. Кудрявцев Е.М. Основы автоматизированного проектирования. –М, 2011. 2. Лазарева Т.Я. Интегрированные системы проектирования и управления. – М, 2010. 3. Семенов А.С. Интегрированные системы проектирования и управления. – М: 2008. 4. Кондаков А.И. САПР технологических процессов. - М.: Академия, 2010. 5. Малюх В.Н. Введение в современные САПР: курс лекций. - М.: «ДМК», 2010. |

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| **Module name** | **MAC-M07/02 "Automation of Technical Systems"** |
| **Semester(s) in which the module is taught** | 1 |
| **Person responsible for the module** | Professor, cand.tech.sc. Mukhanov Bakhyt Kaskabayevich |
| **Language** | Russian |
| **Relation to curriculum** | **Elective**  with "Control Systems for Technological Complexes" |
| **Teaching methods** | Lecture, laboratory works, calculation and graphic works, Master’s self-study work under teacher’s supervision (MSWS) |
| **Working hours (incl. class hours, self-study hours)** | **Total working hours:** 90 hours  **Class hours:**  Lectures -15; Laboratory classes - 15; SSW – 54 (MSWS-5)  **Examination preparation hours:** 6 |
| **Credits** | 3 |
| **Required and recommended prerequisites for joining the module** | Linear Automatic Control Systems; Non-linear Automatic Control Systems |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  Studying the features of technical systems as objects of control, mathematical modeling of objects and systems, issues of optimal control in technical systems.  **LEARNING OUTCOMES:**  **Knowledge:** of modern theoretical foundations of technical systems construction; methods of analysis and synthesis of technical systems; methods of optimal controllers design.  **Skills:**  To analyze typical technical systems; design effective automation systems.  **Competences:**  construction of technical automation systems; designing of continuous and discrete systems; analysis and synthesis of various standard systems.  **to form** applied problems solutions of automating technical systems in various industries, designing tasks of human-machine control systems. |
| **Content** | General information about automation. Features of technical systems as control objects. Industrial automatic control systems (ACS). Classification and main characteristics of regulators. Means of automation of technical systems. Real-time process control using controllers and control computers. Mathematical modeling of objects and systems. Identification of mathematical models. Optimal control in technical systems. Schemes of automation of standard technical systems. Remote control in technical systems. |
| **Current control** | Calculation and graphic work, midterm control 1, midterm control 2, tests. |
| **Final control** | Examination |
| **Study and examination requirements** | **Facilities for successful module implementation**:  Laboratory equipment, PC, Software |
| **References** | 1. Кудрявцев Е.М. Основы автоматизированного проектирования. –М, 2011. 2. Лазарева Т.Я. Интегрированные системы проектирования и управления. – М, 2010. 3. Семенов А.С. Интегрированные системы проектирования и управления. – М: 2008. 4. Кондаков А.И. САПР технологических процессов. - М.: Академия, 2010.   5. Малюх В.Н. Введение в современные САПР: курс лекций. - М.: «ДМК», 2010. |

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| **Module name** | **МАC-М09**  **“Theory and Practice of Project Management”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | Madina Aliyarova, c.t.s., certified project manager (№СРМ 00059) Kaz. Rus. Eng. |
| **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; Lab 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** | **MAC-M10/01 "Methods and Models of CADS of Automation Systems in HPE"** |
| **Semester(s) in which the module is taught** | 2 |
| **Person responsible for the module** | Professor, Doctor of tech.sc. Utepbergenov Irbulat Turemuratovich |
| **Language** | Russian |
| **Relation to curriculum** | **Elective**  with "Methods and models of CAD of automation systems in EE " |
| **Teaching methods** | Lecture, laboratory works, calculation and graphic works, Master’s self-study work under teacher’s supervision (MSWS) |
| **Working hours (incl. class hours, self-study hours)** | **Total working hours:** 150 hours  **Class hours:**  Lectures-15; Laboratory classes - 30; SSW – 99 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended prerequisites for joining the module** | Linear Automatic Control Systems; Nonlinear Automatic Control Systems;  Methods for the Expression of Uncertainty in Measurementt (Fundamentals of Measurement Uniformity and Technical Regulation), Theory and Technique of Engineering Experiment (Experiment Planning). |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  Basic principles study of mathematical modeling and automated design of systems and automation tools used in the heat and power complex, consolidating of the development skills and research of their models**.**  **LEARNING OUTCOMES:**  **Knowledge:**  Of requirements for CAD hardware, principles of automated design of automation systems.  **Skills:** to design hardware and software systems; compose algorithms and application programs in CAD for automation of technical systems in the heat and power complex;  **Competences:** development of models for automation systems; automation systems design using CAD packages; use of mathematical modeling and automated design of systems and automation tools used in the heat and power complex. |
| **Content** | General approaches and principles of modeling and automated design. Structure and characteristics of various software packages used in the heat and power complex. Functionality of software packages and preparation for solving practical problems in the field of computer modeling and design of automation systems for heat power engineering. |
| **Current control** | Calculation and graphic work, Midterm control 1, Midterm control 2, tests. |
| **Final control** | Examination |
| **Study and examination requirements** | **Facilities for successful module implementation**:  PC, Software |
| **References** | 1. Норенков И.П. Введение в современные САПР: курс лекций.- М.: «ДМК Пресс», 2006 2. Кондаков А.И. САПР технологических процессов. - М.: Академия, 2010. 3. Малюх В.Н. Введение в современные САПР: курс лекций. - М.: «ДМК», 2010. 4. Сагындыкова Ш.Н. Методы и модели САПР систем автоматизации в ТЭ. Конспект лекции для магистрантов специальности 6М070200 – АУ: АУЭС, 2017. 5. Сагындыкова Ш.Н. Методы и модели САПР систем автоматизации в ТЭ. Методические указания по выполнению лабораторных работ для магистрантов специальности 6М070200 – АУ: АУЭС, 2020.   6. Утепбергенов И.Т. Ақпараттық жүйелердегі деректер қоры. – АУЭС, 2016. |

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| **Module name** | **MAC-M10/02 "Methods and models of CADS of automation systems in EE"** |
| **Semester(s) in which the module is taught** | 2 |
| **Person responsible for the module** | Professor, Doctor of tech.sc. Utepbergenov Irbulat Turemuratovich |
| **Language** | Russian |
| **Relation to curriculum** | **Elective**  with "Methods and Models of CAD of Automation Systems in HPE" |
| **Teaching methods** | Lecture, laboratory works, calculation and graphic works, Master’s self-study work under teacher’s supervision (MSWS) |
| **Working hours (incl. class hours, self-study hours)** | **Total working hours:** 150 hours  **Class hours:**  Lectures-15; Laboratory classes - 30; SSW – 99 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended prerequisites for joining the module** | Linear Automatic Control Systems; Nonlinear Automatic Control Systems;  Methods for the Expression of Uncertainty in Measurementt (Fundamentals of Measurement Uniformity and Technical Regulation), Theory and Technique of Engineering Experiment (Experiment Planning) |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  Study and mastering of methods and means of automated design modeling of automation systems for electric power facilities.  **LEARNING OUTCOMES:**  **Knowledge:** of principles and systematic approach procedures to the automated design task of a technological process for electric power facilities; principles of automated design and modeling of automation systems for electric power facilities using SCADA systems.  **Skills:** to compose algorithms and application programs in CAD for microprocessor; manage hardware complexes of automation systems for electric power facilities using Modbus communication protocols.  **Competences:**  **to work** in the SCADA-system environment (SCADA TRACE MODE).  **To understand** the nature and possibilities of automated design structure methods and technological processes at various levels of the systems hierarchy, and automation tools used in the electric power complex.  **To have** a basic understanding and development methods of mathematical models at various hierarchical levels of structures of automation systems for power industry facilities. |
| **Content** | Principles of creating CAD designs and technologies, comparative analysis and CAD classification, typical CAD EPS structure and its place among other automation systems. Technical means of CAD and their development. Considering that CAD is an automated information system, the principles of creating CAD EES software types are considered: technical, methodological, mathematical, linguistic, software and information. Extensive material on automated design methods and mathematical models and algorithms of EES SA structures and technological processes of various levels of hierarchy is presented. |
| **Current control** | Calculation and graphic work, Midterm control 1, Midterm control 2, tests. |
| **Final control** | Examination |
| **Study and examination requirements** | **Facilities for successful module implementation**: PC, Software |
| **References** | 1. Норенков И.П. Введение в современные САПР: курс лекций.- М.: «ДМК Пресс», 2006 2. Кондаков А.И. САПР технологических процессов. - М.: Академия, 2010. 3. Малюх В.Н. Введение в современные САПР: курс лекций. - М.: «ДМК Пресс», 2010. 4. Семенов А.С. Интегрированные системы проектирования и управления. Объектно-ориентированный подход. – М., 2008. 5. Сагындыкова Ш.Н. Методы и модели САПР систем автоматизации в ТЭ. Конспект лекции для магистрантов специальности 6М070200 – АУ: АУЭС, 2017. 6. Сагындыкова Ш.Н. Методы и модели САПР систем автоматизации в ТЭ. Методические указания по выполнению лабораторных работ для магистрантов специальности 6М070200 – АУ: АУЭС, 2020. 7. Утепбергенов И.Т. Ақпараттық жүйелердегі деректер қоры. – АУЭС, 2016.   8. Руководство пользователя TRACE MODE 6 & T-FACTORY. Издание восьмое (к релизу 6.07) 064.18957709.0001-01 90 01 ТУ 5043-001-18957709-00. Москва, 2010. |

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| **Module name** | **МАC-М11/01 “Industrial Networks of Distributed Automation Systems”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | Professor, c.t.s. Aksholpan Kopesbaeva |
| **Language** | Russian |
| **Relation to curriculum** | **Elective**  with “Industrial Networks Technologies” |
| **Teaching methods** | lecture, practical seminars, laboratory works, course project, Master’s self-study work under teacher’s supervision (MSWS) |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; laboratory classes - 30; SSW – 99 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Theory and Technique of Engineering Experiment (Experiment Planning), Control Systems for Technological Complexes (Automation of Technical Systems) |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  To study of modern technologies for data transmission between elements of an automation system, mastering the structural construction of distributed control systems, modern principles for constructing software and hardware automation systems  **LEARNING OUTCOMES:**  **Knowledge:**  Students will know modern information technologies in data transmission of automated process control systems, wireless means of communication, approaches to building a DCS based on modern means of data transmission.  Abilities:  Students will be able to select software units from the library of industrial controller functions for specific regulation and control tasks; use software methods for modeling the intelligence of an industrial controller  **Skills:** Demonstrate controller programming skills for complex control and regulation tasks  **Competences:**  Students will have an experience of developing MES-systems that ensure the interaction of subsystems in order to receive and transmit technological and control data |
| **Content** | modern information technologies for data transmission between elements of an automation system, structural construction of distributed control systems, wireless means of communication, modern principles for constructing software and hardware automation systems. |
| **Current control** | Course paper, mid-term control 1, mid-term comtrol 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | **Facilities for successful module implementation:**  Laboratory equipment, Personal computer, software. |
| **References** | 1. Кангин В.В. Аппаратные и программные средства систем управления. Промышленные сети и контроллеры. – М, 2013. 2. Борисов А.М. Основы построения промышленных сетей автоматики. – М, 2014. 3. Зимин В.В. Промышленные сети: учеб.пособие для студентов вузов. - НГТУ. Н.Новгород, 2010. 4. Ian Verhappen, Augusto Pereira. Foundation Fieldbus. ISBN-13 : 978-1937560201, 2012. 5. Fieldbus and Networking in Process Automation. SBN 9780367712389 Published April 29, 2021 by CRC Pres |

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| **Module name** | **МАC-М11/02 «Industrial Network Technologies»** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | Professor, c.t.s. Aksholpan Kopesbaeva |
| **Language** | Russian |
| **Relation to curriculum** | **Elective**  with “Industrial Networks of Distributed Automation Systems” |
| **Teaching methods** | lecture, practical seminars, laboratory works, course project, Master’s self-study work under teacher’s supervision (MSWS) |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; laboratory classes - 30; SSW – 99 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Theory and Technique of Engineering Experiment (Experiment Planning), Control Systems for Technological Complexes (Automation of Technical Systems) |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  tostudy modern data transmission technologies and industrial network protocols, mastering the structural construction of distributed control systems for industrial controllers, modern principles of building an industrial automation network  **LEARNING OUTCOMES:**  **Knowledge:** to know modern information technologies in data transmission of automated process control systems, wireless means of communication, approaches to building DCS based on modern means of data transmission.  **Abilities:** be able to configure industrial networks PROFIBUS, Foundation Fieldbus H1 and H2, HART settings - data transfer protocol, use standards when preparing documentation for DCS hardware and software.  **Skills:**  To have skills in building DCS, SCADA systems; in choosing technical means of information transmission in the design of process control systems.  **Apply** modern data transfer technologies between APCS elements when designing automation systems. |
| **Content** | Basic information on industrial networks and their topology. Hart - protocol. Profinet network. Wireless data transmission systems (Wi-Fi, Wireless systems). Radio, GSM modems. Web-technologies in process control systems. Construction of modern distributed control systems (DCS). |
| **Current control** | Course paper, mid-term test 1, mid-term test 2, tests. |
| **Final control** | Examination |
| **Study and examination requirements** | **Facilities for successful module implementation:**  Laboratory equipment, personal computer, software |
| **References** | 1. Кангин В.В. Аппаратные и программные средства систем управления. Промышленные сети и контроллеры. – М, 2013. 2. Борисов А.М. Основы построения промышленных сетей автоматики. – М, 2014. 3. Зимин В.В. Промышленные сети: учеб.пособие для студентов вузов. - НГТУ. Н.Новгород, 2010. 4. Ian Verhappen, Augusto Pereira. Foundation Fieldbus. ISBN-13 : 978-1937560201, 2012. 5. Fieldbus and Networking in Process Automation. SBN 9780367712389 Published April 29, 2021 by CRC Pres |

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| **Module name** | **МАC-М12/01 Integration of Digital Technology into Automation Control Systems** |
| **Semester(s) in which the module is taught** | 2 |
| **Person responsible for the module** | Professor, Cand.tech.sc. Mukhanov Bakhyt Kaskabaevich |
| **Language** | Russian |
| **Relation to curriculum** | **Elective**  with " Dispatch Systems of Automation Tasks " |
| **Teaching methods** | lecture, laboratory works, course project, Master’s self-study work under teacher’s supervision (MSWS) |
| **Working hours (incl. class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; laboratory classes - 30; SSW – 99 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended prerequisites for joining the module** | Methods for the Expression of Uncertainty in Measurementt (Fundamentals of Measurement Uniformity and Technical Regulation), Control Systems for Technological Complexes (Automation of Technical Systems) |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  to teach Master’s students to understand the principles of construction and operation of a microprocessor as an element of process control systems, to form knowledge of principles of digital systems use in automation and control  **LEARNING OUTCOMES:**  **To demonstrate knowledge** of the design and operation of serial digital and software and hardware automation tools principles.  **To demonstrate the ability** to choose digital and software and hardware tools for creating ACR and ACS; select and operate digital and software and hardware automation tools; apply various automated control systems.  To demonstrate the experience of designing automation equipment with specified characteristics from typical digital elements; integrate digital technology into automation and control systems. |
| **Content** | General patterns of selection and operation of digital and software and hardware means of automation of technological processes. Digital systems, microprocessors, and microcomputers. Logical elements. Storage devices. An interface concept. I/O ports. Architecture of microprocessors. Digital-analog converters. Analog to digital converter. Quantization. |
| **Current control** | Course work, Midterm control 1, Midterm control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | **Requirements for successful module completion:**  Laboratory equipment, Personal computer, software. |
| **References** | 1. Солонина А.И. Цифровая обработка сигналов и MATLAB. – М., 2013. 2. Потехин В.А. Схемотехника цифровых устройств. – М., 2012. 3. Умняшкин С.В. Основы теории цифровой обработки сигналов. – М., 2016. 4. Кангин В.В. Аппаратные и программные средства систем управления. Промышленные сети и контроллеры. – М., 2013. 5. Копесбаева А.А. Микропроцессорные комплексы в системах управления. – Алматы: АУЭС, 2010. 6. Атовмян И.О. Оптимизация тестирования сложных цифровых устройств. – Ростов-на-Дону, 2014. 7. Карташова Б.А. Компьютерные технологии микропроцессорные средства в автоматическом управлении. – Ростов-на-Дону, 2013. |

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| **Module name** | **МАC-М12/02 “Dispatch Systems of Automation Tasks”** |
| **Semester(s), in which the module is taught** | 2 |
| **Person, responsible for the module** | Professor , c.t.n. Bakhyt Mukhanov |
| **Language** | Russian |
| **Relation to curriculum** | **Elective**  with “Integration of Digital Technology into Automation Control Systems” |
| **Teaching methods** | lecture, laboratory works, course project, Master’s self-study work under teacher’s supervision (MSWS) |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; laboratory classes - 30; SSW – 99 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Methods for the Expression of Uncertainty in Measurementt (Fundamentals of Measurement Uniformity and Technical Regulation), Control Systems for Technological Complexes (Automation of Technical Systems) |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  to teach undergraduates to understand the principles of building dispatching systems as an element of SCADA and MES systems.  **LEARNING OUTCOMES:**  **Knowledge:** toknow the principles of design and operation of serial digital and software-hardware means of automation; principles of construction and operation of dispatching systems.  **Skills:** be able to design automation tools with specified characteristics from typical digital elements; choose digital and software and hardware tools for creating dispatching systems; select and operate digital, software and hardware automation tools and apply them in dispatching systems.  **Competences:** to have an experience in designing and creating dispatching systems of automation tasks based on microcontrollers and modern SCADA systems. |
| **Content** | Architecture of microprocessors. Digital-analog converters. Analog and digital converter. General principles for building dispatching systems. Languages ​​and tools for developing dispatching systems. Modern SCADA systems. MES systems and dispatching |
| **Current control** | Course paper, Mid-term 1, mid-term 2, tests. |
| **Final control** | Examination |
| **Study and examination requirements** | **Facilities for successful module implementation:**  Laboratory equipment, Personal computer, software. |
| **References** | 1. Солонина А.И. Цифровая обработка сигналов и моделирование в MATLAB. – М., 2008. 2. Солонина А.И. Цифровая обработка сигналов в MATLAB. – М., 2013. 3. Потехин В.А. Схемотехника цифровых устройств. – М., 2012. 4. Умняшкин С.В. Основы теории цифровой обработки сигналов. – М., 2016. 5. Кангин В.В. Аппаратные и программные средства систем управления. Промышленные сети и контроллеры. – М., 2013. 6. Копесбаева А.А. Микропроцессорные комплексы в системах управления. – Алматы: АУЭС, 2010. 7. Атовмян И.О. Оптимизация тестирования сложных цифровых устройств. – Ростов-на-Дону, 2014. |

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| **Module name** | **MAC-M13/01 "Intelligent Control Systems"** |
| **Semester(s) in which the module is taught** | 2 |
| **Person responsible for the module** | Professor, Cand.tech.sc. Zhussupbekov Sarsenbek Seitbekovich |
| **Language** | Russian |
| **Relation to curriculum** | **Eelective** with "Neural Network Technologies" |
| **Teaching methods** | Lecture, laboratory works, calculation and graphic works, Master’s self-study work under teacher’s supervision (MSWS) |
| **Working hours (incl. class hours, self-study hours)** | **Total working hours:** 150 hours  **Class hours:**  Lectures -15; Laboratory classes - 30; SSW – 99 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended prerequisites for joining the module** | Methods for the Expression of Uncertainty in Measurementt (Fundamentals of Measurement Uniformity and Technical Regulation), Theory and Technique of Engineering Experiment (Experiment Planning) |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  систематический обзор современных моделей представления знаний, изучить и освоить принципы построения экспертных систем, рассмотреть перспективные направления развития систем искусственного интеллекта и принятия решений.  **LEARNING OUTCOMES:**  **Knowledge of** theories of artificial intelligence technologies (mathematical description of an expert system, logical inference, artificial neural networks, calculation and logic systems, systems with genetic algorithms, multi-agent systems); knowledge representation models; principles of building expert systems; modern systems of artificial intelligence and decision making.  **Skills to** solve applied issues of intelligent systems using Matlab, static expert systems, real-time expert systems; apply various models of knowledge representation in the implementation of expert systems on a computer.  **Competences** of software implementations: development of expert systems on computers; application of promising research methods and solution of professional problems based on global trends knowledge in the development of computer technology and information technology; choice of method and algorithms development for solving problems of control and design of automation objects; application of modern technologies for the software systems development using CASE-tools, quality control of the developed software products. |
| **Content** | Basic concepts of artificial intelligence and intelligent control. Knowledge representation models. Fundamentals of the mathematical apparatus of the fuzzy sets and fuzzy logic theory. Building intelligent control systems for dynamic objects based on fuzzy logic. Fundamentals of artificial neural networks. Various architectures of neural networks. Designing controllers based on artificial neural networks. Genetic algorithms. |
| **Current control** | Calculation and graphic work, Midterm control 1, Midterm control 2, tests. |
| **Final control** | Examination |
| **Study and examination requirements** | **Facilities for successful module implementation**:  PC, Software |
| **References** | 1. Интеллектуальные системы управления: теория, методы, средства. – Алматы: КазНУ им.Аль-Фараби, 2012. 2. Мутанов Г.М. Интеллектуальные системы управления: теория, методы, средства, 2012. 3. Анищенко О.П. Бортовые интеллектуальные системы, 2008. 4. Л. Н. Ясницкий. Интеллектуальные системы. – М., 2016. 5. В. Б.Кудрявцев. Интеллектуальные системы. – М., 2016. 6. Н. Соловьев. Интеллектуальные системы. – М., 2013. 7. Markoff John. Homo Roboticus? People and machines in search of mutual understanding. – 2017.   8. Stuart Russell, Peter Norvig. Artificial Intelligence. Modern Approach. – 2018. |

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| **Module name** | **MAC-M13/02 “Neural Network Technologies”** |
| **Semester(s) in which the module is taught** | 2 |
| **Person responsible for the module** | Professor, Cand.tech.sc. Zhussupbekov Sarsenbek Seitbekovich |
| **Language** | Russian |
| **Relation to curriculum** | **Elective**  with "Intelligent Control Systems" |
| **Teaching methods** | Lecture, laboratory works, calculation and graphic works, Master’s self-study work under teacher’s supervision (MSWS) |
| **Working hours (incl. class hours, self-study hours)** | **Total working hours:** 150 hours  **Class hours:**  Lectures -15; Laboratory classes - 30; SSW – 99 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended prerequisites for joining the module** | Methods for the Expression of Uncertainty in Measurementt (Fundamentals of Measurement Uniformity and Technical Regulation), Theory and Technique of Engineering Experiment (Experiment Planning) |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  Acquaintance with the basic organization principles of software and hardware of neurocomputers and systems; architecture study of the main types of modern neurocomputers, terminology in this subject area, principles of building and training neurocomputers; the ability to use neural networks to solve applied problems.  **LEARNING OUTCOMES:**  Knowledge  Demonstrate knowledge of constructing methods of neural network automatic control systems; methods of research and design of fuzzy inference systems for control purposes; neural networks training basic schemes.  Skills:  Demonstrate the ability to explore modern neural network control systems; develop, create, and study expert management systems.  Demonstrate skills in building neural network automatic control systems; modern mathematical methods for constructing and applying neural network automatic control systems.  Competences:  Demonstrate the experience of creating control systems based on the artificial intelligence theory. |
| **Content** | Fundamentals of the fuzzy sets theory. Fundamentals of creating fuzzy inference systems for control purposes. Classification of neural network control systems. Application, properties, and architectures of neural networks. Algorithms for training neural networks. Fundamentals of the genetic algorithms theory. Development, creation and research of expert control systems and neural networks using modern software products. |
| **Current control** | Calculation and graphic work, Midterm control 1, Midterm control 2, tests. |
| **Final control** | Examination |
| **Study and examination requirements** | **Facilities for successful module implementation**:  PC, Software |
| **References** | 1. Терехов В.А. Нейросетевые системы управления. – М., 2002. 2. Яхъяева Г.Э. Нечеткие множества и нейронные сети. – М., 2008. 3. Рутковская Д. Нейронные сети,генетические алгоритмы и нечеткие системы – М., 2013. 4. Галушкин А.И. Нейронные сети: основы теории. – М., 2015. 5. Потемкин В.Г. Matlab 6: среда проектирования инженерных приложений. – М., 2003.   6. Luger D.F. Artificial Intelligence: Strategies and Methods for Solving Complex Problems, 2003. |

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| **Module name** | **MAC-M14/01/02 "Research Practice"** |
| **Semester(s) in which the module is taught** | 2 and 4 |
| **Person responsible for the module** | Khan Svetlana Guryevna, Cand.tech.sc., professor. |
| **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** | **MAU-M15 "Methods of Modern Theory of Automatic Control"** |
| **Semester(s) in which the module is taught** | 3 |
| **Person responsible for the module** | Abzhanova Laulasyn Kasylganovna, PhD, associate professor |
| **Language** | Russian |
| **Relation to curriculum** | **Compulsory** |
| **Teaching methods** | Lecture, practical seminars, laboratory works, calculation and graphic works, Master’s self-study work under teacher’s supervision (MSWS) |
| **Working hours (incl. class hours, self-study hours)** | **Total working hours:** 150 hours  **Class hours:**  Lectures-15; Practice -15; Laboratory classes - 15; SSW – 99 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended prerequisites for joining the module** | Theory and Practice of Project Management, Methods and Models of CAD of Automation Systems in HPE (Methods and Models of CAD of Automation Systems in EE), Control Systems for Technological Complexes (Automation of Technical Systems) |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  The modern methods study of the automatic control theory, including mathematical models of control objects in the state space, the stability study of nonlinear systems.  **LEARNING OUTCOMES:**  **Knowledge** of the basic describing concepts of control objects in the state space; study approaches of nonlinear systems stability by Lyapunov's methods; constructing methods of adaptive automatic control systems.  **Formulate** problem solutions of description in the state space and study of controllability and observability of control objects; study problems of stability of automatic control systems by Lyapunov methods; constructing problems of adaptive automatic control systems.  **Demonstrate** mastery of modern methods of automatic control systems study in the state space; use of modern application packages for modeling automatic control systems given in the state space.  **Analyze and set** adaptive control tasks of technological objects in various industries. |
| **Content** | modern methods of automatic control theory, mathematical models of control objects in the state space, properties of controllability and observability, studies of the stability of nonlinear systems by Lyapunov methods, methods for constructing adaptive control systems. |
| **Current control** | Calculation and graphic work, Midterm control 1, Midterm control 2, tests. |
| **Final control** | Examination |
| **Study and examination requirements** | **Facilities for successful module implementation**:  Laboratory equipment, PC |
| **References** | 1. Первозванский А.А. Курс теории автоматического управления.- М, 2010. 2. Бекбаев А. Сызықты және бейсызықты автоматты реттеу жүйесінің теориясы. Есептер жинағы. – 2012.   Lopez C.R. Control Systems using MatLab. – 2014. |

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| **Module name** | **МАC-М16/01 “Software for Microprocessor Controllers in Automation Tasks”** |
| **Semester(s), in which the module is taught** | 3 |
| **Person, responsible for the module** | Professor, c.t.s. Aksholpan Kopesbaeva |
| **Language** | Russian |
| **Relation to curriculum** | **Elective**  with "Libraries of Software Systems for Industrial Controllers" |
| **Teaching methods** | lecture, practical seminars, laboratory works, course project, Master’s self-study work under teacher’s supervision (MSWS) |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; practical classes -15; laboratory classes - 15; SSW – 99 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Theory and Practice of Project Management, Integration of Digital Technology into Automation Control Systems (Dispatch Systems of Automation Tasks), Industrial Networks of Distributed Automation Systems (Industrial Network Technologies) |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  to teach master’s students to use the architectural capabilities of controllers for implementation of the managing tasks and the tasks of regulating automation processes  **LEARNING OUTCOMES:**  To know the principles of construction and creation of control systems; hardware programming language for microprocessor controllers; principles of designing control rooms based on SCADA.  **Skills:** designing the main hardware products of control systems; designing software for control systems.  **Competences:** Using the architectural capabilities of microcontrollers for implementation the managing tasks and the tasks of regulating automation processes. |
| **Content** | Automation systems for continuous and discrete processes. Features of the functioning of these systems. Features of microprocessor controllers’ application. Classification of software for microprocessor controllers. “Simatic” software products from “Siemens”. Specific schemes of microprocessor control systems. |
| **Current control** | Course project, mid-term test 1, mid-term test 2, Tests |
| **Final control** | Examination |
| **Study and examination requirements** | **Facilities for successful module implementation:**  Personal computer, software, Siemens laboratory equipment |
| **References** | 1. Петров И.В. Программируемые контроллеры. Стандартные языки и приемы прикладного проектирования. – М., 2008. 2. Э.Парр. Программируемые контроллеры: руководство для инженера. - М.:БИНОМ, 2011. 3. Юрген Мюллер. Регулирование на основе SIMATIC Практическое пособие по регулированию на основе SIMATIC и SIMATIC РСS7, 2002. 4. Jie Bao and Peter L. Lee. Process Control: The Passive Systems Approach (Advances in Industrial Control), 2010. 5. Копесбаева А.А. Микропроцессорные комплексы в системах управления.- Алматы: АУЭС, 2010. |
| **Module name** | **MAC-M16/02 "Libraries of Software Systems for Industrial Controllers"** |
| **Semester(s) in which the module is taught** | 3 |
| **Person responsible for the module** | Professor, cand.tech.sc. Kopesbayeva Aksholpan Auelbekovna |
| **Language** | Russian |
| **Relation to curriculum** | **Elective**  with "Software for Microprocessor Controllers in Automation Tasks" |
| **Teaching methods** | lecture, practical seminars, laboratory work, course project, Master’s self-study work under teacher’s supervision (MSWS) |
| **Working hours (incl. class hours, self-study hours)** | **Total working hours**: 150 hours  Class hours: Lectures -15; practice -15; laboratory classes - 15; SSW – 99 (MSWS -15)  **Examination preparation hours**: 6 |
| **Credits** | 5 |
| **Required and recommended prerequisites for joining the module** | Theory and Practice of Project Management, Integration of Digital Technology into Automation Control Systems (Dispatch Systems of Automation Tasks), Industrial Networks of Distributed Automation Systems (Industrial Network Technologies) |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES:**  to teach undergraduates to fully use the library of automation functions of modern industrial controllers in practical tasks of control and regulation  **LEARNING OUTCOMES:**  **Knowledge:**  construction and creation principles of control systems; hardware programming language for microprocessor controllers; principles of designing control rooms based on SCADA.  **Skills:** designing the main hardware products of control systems; designing software for control systems.  **Competences:** design and development of hardware and software for complex automation and control systems based on SPLC. |
| **Content** | Basic principles of design, operation and development of hardware and software for complex automation and control systems based on SPLC. Algorithms for adaptive and optimal control. Methods of mathematical modeling and identification of control objects in the SPLC software. |
| **Current control** | Course project, Midterm control 1, Midterm control 2, tests |
| **Final control** | Examination |
| **Study and examination requirements** | Facilities for successful module implementation:  PC, Software, laboratory equipment |
| **References** | 1. Петров И.В. Программируемые контроллеры. Стандартные языки и приемы прикладного проектирования. – М., 2008. 2. Э.Парр. Программируемые контроллеры: руководство для инженера. - М.:БИНОМ, 2011. 3. Юрген Мюллер. Регулирование на основе SIMATIC Практическое пособие по регулированию на основе SIMATIC и SIMATIC РСS7, 2002. 4. Jie Bao and Peter L. Lee. Process Control: The Passive Systems Approach (Advances in Industrial Control), 2010. 5. Копесбаева А.А. Микропроцессорные комплексы в системах управления.- Алматы: АУЭС, 2010. |

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| **Module name** | **МАC-М17/01 “Synthesis of Optimal Control Systems”** |
| **Semester(s), in which the module is taught** | 3 |
| **Person, responsible for the module** | Professor, c.t.s. Sarsenbek Zhussupbekov |
| **Language** | Russian |
| **Relation to curriculum** | **Elective**  with “Adaptive identification technologies” |
| **Teaching methods** | lecture, laboratory works, calculation graphic work, Master’s self - study work under teacher’s supervision (MSWS) |
| **Working hours (including class hours, self-study hours)** | **Working hours:** 150 hours  **Class hours:**  lectures -15; laboratory classes - 30; SSW – 99 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended pre-requisites for joining the module** | Theory and practice of project management, Intelligent control systems (Neural network technologies), Integration of Digital Technology into Automation Control Systems (Dispatch Systems of Automation Tasks) |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  to study the theoretical foundations, principles and mathematical methods for constructing optimal control systems and methods for their calculation and design.  **LEARNING OUTCOMES:**  **Knowledge:** to know the theoretical foundations, principles and mathematical methods for constructing optimal control systems; methods of their research and design; basic schemes for optimizing automatic control systems.  **Abilities:** be able to explore modern optimal control systems; to calculate and design optimal control systems.  **Skills:** to have skills in building optimal control systems; application of various automatic control systems;  **Competences:** to have an experience in designing and developing an optimal control system. |
| **Content** | Calculation work on the creation and introduction into operation of automatic systems of optimal control with the wide use of modern computer technology. |
| **Current control** | Calculation and graphic work, mid-term test 1, mid-term test 2, tests. |
| **Final control** | Examinations |
| **Study and examination requirements** | **Facilities for successful module implementation:**  Personal computer, software. |
| **References** | 1. Малафеев С.И. Теория автоматического управления: учебник. –М., 2014. 2. Адамбаев М. Автоматты басқару теориясы. – 2015. 3. Тойгожинова Ж. Ж. Автоматты басқару теориясы. – 2018. 4. Bavafa-Toosi Y. Introduction to Linear Control Systems, 2017. |

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| **Module name** | **МАC-М17/02 «Adaptive Identification Technologies»** |
| **Semester(s) in which the module is taught** | 3 |
| **Person responsible for the module** | Professor, cand.tech.sc. Zhusupbekov S.S. |
| **Language** | Russian |
| **Relation to curriculum** | **Elective**  with « Synthesis of Optimal Control Systems» |
| **Teaching methods** | Lecture, laboratory works, calculation and graphic works, Master’s self - study work under teacher’s supervision (MSWS) |
| **Working hours (incl. class hours, self-study hours)** | **Total working hours:** 150  Lectures -15; Laboratory classes - 30; SSW- 99 (MSWS -15)  **Examination preparation hours:** 6 |
| **Credits** | 5 |
| **Required and recommended prerequisites for joining the module** | Theory and practice of project management, Intelligent control systems (Neural network technologies), Integration of Digital Technology into Automation Control Systems (Dispatch Systems of Automation Tasks) |
| **Module objectives/intended learning outcomes** | **MODULE OBJECTIVES**:  Modern methods of structural and parametric identification of control objects study and their application in the adaptive control systems construction.  **LEARNING OUTCOMES:**  **Knowledge:**  of theoretical foundations, principles, and mathematical methods for adaptive automatic control systems construction; research methods and adaptive automatic control systems design.  **Skills:**  To explore modern adaptive control systems; to calculate and design adaptive automatic control systems.  **Competences:**  building of adaptive automatic control systems.  **Experience:** application of modern methods of structural and parametric identification using computer technology and modern software products and their application in the of adaptive control systems construction. |
| **Content** | Theoretical foundations, principles, and mathematical methods for constructing identification of control systems adaptive technologies. Methods of calculation and design of control systems. Calculation work on the creation and implementation of adaptive control systems with wide use of modern computer technology. |
| **Current control** | Calculation and graphic work, midterm control 1, midterm control 2, tests. |
| **Final control** | Examination |
| **Study and examination requirements** | **Facilities for successful module implementation**:  PC, Software. |
| **References** | 1. Малафеев С.И. Теория автоматического управления: учебник. –М., 2014. 2. Адамбаев М. Автоматты басқару теориясы. – 2015. 3. Тойгожинова Ж. Ж. Автоматты басқару теориясы. – 2018. 4. Bavafa-Toosi Y. Introduction to Linear Control Systems, 2017. |

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| **Module name** | **MAC-M18 "Pedagogical practice"** |
| **Semester(s) in which the module is taught** | 3 |
| **Person responsible for the module** | Professor, Cand tech sc. Khan Svetlana Gurievna |
| **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 "Automation and Control" DP; 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 AU 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. |