ASIIN Seal

Accreditation Report

Bachelor's Degree Programmes
Intelligent Control Systems
Industrial Electronics and Control Systems

Master's Degree Programmes
Intelligent Control Systems
Electronics and Control Systems

PhD Programmes
Intelligent Control Systems
Automation and the Internet of Things

Provided by
Al-Farabi Kazakh National University

Version: 12 July 2024

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A About the Accreditation Process

Name of the degree programme (in original language)	(Official) English translation of the name	Labels applied for [1]	Previous accreditation (issuing agency, validity)	Involved Technical Committees (TC)[2]
6B07113 Интеллектуальные системы управления	6B07113 Intelligent Control Systems	ASIIN	ASIIN 31.03.2017-30.09.2022	TC 02/04
7M07128 Интеллектуальные системы управления	7M07128 Intelligent Control Systems	ASIIN	ASIIN 31.03.2017-30.09.2022	TC 02/04
8D07116 Интеллектуальные системы управления	8D07116 Intelligent Control Systems	ASIIN	ASIIN 31.03.2017-30.09.2022	TC 02/04
6B07109 Промышленная электроника и системы управления	6B07109 Industrial Electronics and Control Systems	ASIIN		TC 02/04
7M07125 Электроника и системы управления	7M07125 Electronics and Control Systems	ASIIN		TC 02/04
8D07109 Автоматизация и Internet of Things	8D07109 Automation and Internet of Things	ASIIN		TC 02/04
Date of the contract: 26.09.2022 **Submission of the final version of the self-assessment report:** 10.02.2023				

[1] ASIIN Seal for degree programmes

[2] TC: Technical Committee for the following subject areas: TC 02 - Electrical Engineering/Information TechnologyTC 04 - Informatics/Computer Science.

Date of the onsite visit: 02.-04.05.2023 **at:** Al-Farabi Kazakh National University, Faculty of Information Technology	
Peer panel: Prof. Dr.-Ing. Christoph Rappl - Deggendorf Institute of Technology Prof. Dr. Ralf Müller - University of Erlangen-Nuremberg Aizhan Ydyrys, PhD – International Information Technology University Shakhnazar-Sultan Manbay – Student at Suleyman Demirel University, Kaskelen	
Representative of the ASIIN headquarter: Sascha Warnke	
Responsible decision-making committee: Accreditation Commission for Degree Programmes	
Criteria used: European Standards and Guidelines as of May 15, 2015 ASIIN General Criteria, as of December 10, 2015 Subject-Specific Criteria of Technical Committee 02 – Electrical Engineering/Information Technology as of December 9, 2011 ASIIN Additional Criteria for Structured Doctoral Programmes as of March 15, 2021	

B Characteristics of the Degree Programmes

a) Name	Final degree (original/English translation)	b) Areas of Specialization	c) Corresponding level of the EQF[3]	d) Mode of Study	e) Double/Joint Degree	f) Duration	g) Credit points/unit	h) Intake rhythm & First time of offer
6B07113 Intelligent Control Systems	Бакалавр техники и технологий / Bachelor of Engineering and Technology	Industrial automation, automation of energy saving by industry	6	Full time		8 Semesters	240 ECTS	Yearly, since 2015
7M07128 Intelligent Control Systems	Магистр технических наук / Master of Engineering Sciences	Industrial automation, energy saving automation by industry Automation IoT	7	Full time		4 Semesters	120 ECTS	Each semester, since 2015
8D07116 Intelligent Control Systems	Доктор философии / Doctor of Philosophy	Industrial automation, remote control of unmanned vehicles, intelligent process control, automation of control processes in a smart city	8	Full time		6 semesters	180 ECTS	Each semester, since 2022
6B07109 Industrial Electronics and Control Systems	Бакалавр техники и технологий / Bachelor of Engineering and Technology	A complex of hardware and software designed for automation of production processes	6	Full time		8 Semesters	240 ECTS	Yearly, since 2022
7M07125 Electronics and Control Systems	Магистр технических наук / Master of Engineering Sciences	Scientific and technical approaches to solving automation and control problems arising at various stages of the creation and operation of hardware and software for automated process control systems	7	Full time		4 Semesters	120 ECTS	Each semester, since 2022

[3] EQF = The European Qualifications Framework for lifelong learning

a) Name	Final degree (original/English translation)	b) Areas of Specialization	c) Corresponding level of the EQF[3]	d) Mode of Study	e) Double/Joint Degree	f) Duration	g) Credit points/unit	h) Intake rhythm & First time of offer
8D07109 Automation and Internet of Things	Доктор философии / Doctor of Philosophy	Automation of renewable energy systems (biofuels, solar panels, oil and gas sector, gas transmission system), intelligent regulators in IoT, industrial IoT	8	Full time		6 semesters	180 ECTS	Each semester, since 2022

Al-Farabi Kazakh National University (KazNU) is the largest and oldest higher-education institutes in Kazakhstan. The public research university was founded in 1934 and is located in Almaty, the biggest city in Kazakhstan with a population of over 1.7 million.

KazNU consists of 16 faculties, offering a wide array of undergraduate and graduate programs in both STEM-fields and humanities. It currently enrols about 26,000 students, 4,000 of whom are postgraduates.

In 2018, KazNU opened the Faculty of Information Technology in accordance with the State programme “Digital Kazakhstan” of the same year, the stated aim of which is furthering the digitalization within in the country. In doing so, the Kazakh government is expected to educate 100,000 qualified specialists in the field of digitalization. The faculty focuses on teaching and researching on the subjects of information technology, artificial intelligence, as well as big data.

KazNU presents six programmes here for review; for one a field of study called “Intelligent Control Systems” that consists of a Bachelor’s, Master’s, and PhD program. These have already been accredited by ASIIN in 2017. The remaining programs are a Bachelor’s degree program called “Industrial Electronics and Control Systems”, a Master’s programme titled “Electronics and Control Systems”, as well as a PhD programme under the name “Automation and the Internet of Things.”

For the programmes titled “Intelligent Control Systems” the institution has presented the following profile in the self-assessment report:

The Bachelor’s degree programme “provide[s] quality training for competitive specialists in the design, implementation and use of modern intelligent IoT devices, design and maintenance of software for IoT devices, control and intellectualization of existing automated technological processes in the industry, small and medium business.“

The Master's degree programme "provide[s] high-quality training for specialists in the scientific, educational and industrial fields related to the implementation of intelligent management systems and solutions of "Industry 4.0", capable of independent research on various IoT platforms using large analysis methods data and cloud technology."

The PhD programme "provide[s] high-quality training of scientific and scientific and pedagogical personnel of the highest qualification for the system of higher and postgraduate education, the research sphere, scientific and production structures related to innovations and the introduction of modern achievements in the field of automation, and management able to carry out independent research with a projection on the development of promising areas of intelligent control systems, predict the results of innovative activities, manage complex industrial and scientific processes."

For the Bachelor's programme "Industrial Electronics and Control Systems", the institution presents the following description in their self-assessment report: The program "provide[s] training of highly qualified, competitive specialists with sufficient knowledge and skills of system understanding necessary to solve engineering problems, as well as to perform advanced engineering research. Also, to form human resources for the domestic and international labor market in the field of electronics and control systems in accordance with the development prospects of the Republic of Kazakhstan, which is able to modernize production technologies in order to increase efficiency."

The Master's programme "Electronics and Control Systems" is presented with the following description in the institution's self-assessment report: "The purpose of the educational program is to provide training of highly qualified specialists in the field of industrial electronics and control systems, capable of conducting scientific research using electronic and computing devices, using modern software for modeling and designing control systems, conducting researches in scientific institutions, industrial and innovation centers."

Lastly, the PhD programme "Automation and Internet of Things" should, according to the self-assessment report of the institution, "provide high-quality training of scientific and scientific-pedagogical personnel of the highest qualification for the system of higher and postgraduate education, research sphere, scientific and production structures associated with the design and development of systems and means of automatic control of complex technological processes based on IoT technologies and artificial intelligence methods."

C Peer Report for the ASIIN Seal

1. The Degree Programme: Concept, content & implementation

Criterion 1.1 Objectives and learning outcomes of a degree programme (intended qualifications profile)

Evidence:

- Self-assessment report
- Module handbooks
- Learning Objectives-Module Matrices
- Discussion during the audit
- Ministry of Education and Science of the Republic of Kazakhstan, Unified system of management of higher education (http://esuvo.platonus.kz/#/)
- University Website: (https://www.kaznu.kz/en)

Preliminary assessment and analysis of the peers:
Generally speaking, the six programs are intended to familiarize and specialize students of all academic degrees with digitalization. This is in accordance with the stated aim to further the digitalization within the country by educating personnel that is knowledgeable in the field of automation, the internet of things and electronics.

The four-years Bachelor's program "Intelligent Control Systems (Automation and Control)" is taught in Kazakh, Russian, and English. Graduates of this program should be able to manage, analyze, and monitor IoT devices, as well as design and program software for these devices; They are supposed to do big data analyses and to develop software tools for storing and processing big data; And they should understand methods and tools of electrical engineering and automatic control systems. Additionally, students are educated in higher mathematics and sociocultural subjects, receiving introductory courses in, among others, philosophy, politics, and foreign languages. Lectures are complemented with laboratory courses. A full list of the learning outcomes taken from the self-assessment report follows:

ON1. To analyze the features of social, political, cultural institutions in the context of their role in the modernization of Kazakhstan society, to describe the stages of formation of independent Kazakhstan statehood in the context of the global and Eurasian historical process.

ON2. Use the conceptual apparatus, methods and tools of higher mathematics, automatic control, electrical engineering, automatic control systems for analysis and synthesis of information data streams of measuring instruments of automation systems;

ON3. To manage, analyze and monitor IoT devices in accordance with the approved regulatory documents, metrological characteristics and operating modes of IoT devices.

ON4. Install, maintain and monitor network equipment using information exchange protocols, rules and methods for establishing network connections, basic network services and principles of network security.

ON5. Design, develop and test software, perform conceptual, logical and physical database design, develop applications on local and cloud servers.

ON6. Design software for IoT devices, programme a graphical user interface, application business logic and machine-to-machine interaction for IoT systems.

ON7. Develop a simulation model of the object (process) in question, develop and verify programme code, test and upgrade IoT applications and devices.

ON8. To analyze the subject and problem areas and on its basis to design and develop an intelligent system, apply smart technology to solve applied problems.

ON9. Explore the tasks of managing production and technological processes, apply artificial intelligence methods in solving problems and making decisions, testing, implementing and maintaining intelligent control systems.

ON10. Conduct big data analysis, design and develop software tools for storing, processing and analyzing big data, use the services of cloud platforms to support modern application architectures.

ON11. Develop innovative solutions to integrate new technologies with existing IoT systems and create new intelligent solutions.

ON12.Work in a team, tolerantly perceiving social, ethnic and cultural differences, critically evaluate their activities, the activities of the team.

The Master's program "Intelligent Control Systems" aims at qualifying students to work in the educational, scientific, or industrial field. To do so, the knowledge acquired in the Bachelor's degree program are deepened to give the students a better understanding of IoT systems. Furthermore, students are to learn about how to conduct scientific research and how to educate others. KazNU prescribes the following learning outcomes:

ON1. Apply mathematical methods, models and algorithms in the construction of intelligent control systems, design and use decision support systems in automated systems according to the principles of Industry 4.0.

ON2. Apply network channel security methods, monitor the system to detect vulnerabilities (in the network, in applications, in devices), and ensure the security of IoT systems.

ON3. Conduct an analysis to predict the maintenance of IoT devices, design collective smart M2M device touch models and prototypes of virtual models.

ON4. Develop models of IoT systems according to customer requirements, expand the functionality of IoT systems and improve the performance of individual tasks in accordance with a new or supplemented technical task.

ON5. To develop hardware and software for IoT systems to stimulate innovation in the field of digitalization of the industry, to design and use inter-machine communication software for smart systems.

ON6. Apply software for processing, storage and transmission of cloud data, conduct research in the field of analysis and design of embedded IoT systems using cloud services.

ON7. Develop methods for processing and analyzing big data of corporate systems and applications to improve business processes; Create software tools for storing big data and extracting useful information from them.

ON8. Conduct scientific and pedagogical activity, introduce research results into practical pedagogical activity, lead a research group.

ON9. Independently conduct research, understand current research issues, analyze and critically relate to various sources of information, use them to structure and formulate reasoning.

ON10. Use methods and tools from various multidisciplinary fields, present research results in various forms in national scientific publications, at conferences tailored to the specifics of the audience, be tolerant.

The PhD program “Intelligent Control Systems” focuses on an interdisciplinary approach to the generation and development of automatic control systems. In addition, PhD students are supposed to teach in higher education and perform independent research on an internationally recognized standard. The university prescribes the following learning outcomes for this program:

ON1. State the concepts of system analysis, the basic principles of the synthesis of automatic control systems, create mathematical models in the field of automation of production based on the algorithms of system analysis and process control.

ON2. To design control systems for complex production and scientific processes using the theory of extreme problems, the basic principles of building automatic control systems. To design control systems for complex production and scientific processes using the theory of extreme tasks, the basic principles for constructing automatic control and control systems, methods and criteria for stability analysis.

ON3. Create simulation models of the work of modern educational and industrial controllers, multiprocessor industrial complexes for industrial automation and intellectualization of process control according to the principles of Industry 4.0.

ON4. Design and develop prototypes of IoT devices based on modern microcontrollers, built-in data exchange systems using M2M technology, offer new hypotheses and solutions to scientific problems in the field of intelligent control systems based on an independent original approach.

ON5.Use methods and tools from various multidisciplinary fields, determine the quality parameters of the technological process, intended for intellectualization, evaluate the prospects of using neuroregulators in process control.

ON6.Conduct teaching activities in higher education institutions, introduce advanced and innovative teaching technologies, develop educational and methodological support for new courses, taking into account the social modernization of Kazakhstan and the development of the national economy.

ON7. Apply modern methodology, tools and standards in the field of project management, apply research methods, contribute to original research, draw up research programs, obtain the necessary data from scientific and technical documents, reports and other reference materials.

ON8. Build the research process on the topic of the dissertation, use the academic style of writing, present and discuss research results at conferences, in scientific discussions and publications in national and international peer-reviewed publications, contribute to the development of society, work in a team, support the training of others using research and education, and through other professional skills.

For the Bachelor's degree "Industrial Electronics and Control Systems" the students learn the fundamentals of electronics as well as their underlying mathematical and physical mechanisms. During the program they are taught principles of electronic devices and systems. Furthermore, graduates are supposed to understand the basics of sociocultural subjects such as communication and a foreign language. The university prepared the following list of learning outcomes:

LO1. Understand the basic physical processes underlying electronics, optoelectronics, microelectronics and electrical engineering, apply mathematical methods of calculation, analysis

and modeling of electrical circuits in order to design digital and analog electronic measuring devices and devices for various special purposes.

LO2. Explain the physical and mathematical principles and methods of designing electrical circuits underlying digital processing and encoding of information, data mining, building decision-making algorithms, the basics of control theory, modern methods of designing artificial intelligence for image processing, computer vision, neural networks and machine learning, as well as the design of robotic systems.

LO3. Apply physical and mathematical methods for transmitting, receiving and processing signals in control systems, communication equipment and control and monitoring units, and interpret the results obtained using digital electronic devices in control systems.

LO4. Solve engineering problems in the field of analog and digital electronics, adaptive control systems and robotic systems using modern hardware and software, for the design of electronic devices for various purposes;

LO5. Use modern methods of modeling, programming and simulation to develop functional blocks of industrial electronic devices based on modern microprocessors, microcontrollers, programmable logic integrated circuits and electronic sensors.

LO6. Design electronic devices and digital control units using electrical and optical components, integrated circuits, microprocessors and microcontrollers for the development of digital devices used in industrial electronics using modern hardware and software.

LO7. Integrate and analyze the basic principles of building industrial, converter electronic systems at the hardware level for diagnostics and testing using appropriate software.

LO8. Apply design methods of analog and digital electronic devices, coding, filtering, transmission, reception and protection against failures and unauthorized access to develop industrial intelligent adaptive control systems.

LO9. To organize industrial process control systems using automated process control systems for the design of monitoring systems, remote control and IoT technologies.

LO10. Design and perform calculations of individual blocks and electronic devices, control and automation systems, computing and measuring equipment and robotic systems to solve the technical problem.

LO11. Design digital electronic systems using modern SMART technologies and the Internet of Things to meet the desired needs within real constraints, such as economic, environmental, social, ethical, health and safety, manufacturability and sustainable development.

LO12. Apply the fundamental principles, methodologies and concepts of the culture of interpersonal communication, including in a foreign language, have systematic thinking when setting goals and objectives related to professional activity, form your own point of view in

ideological and civil issues, commercialize the results of professional activity, ensure the protection of intellectual property in the development of electronic and digital devices;

The Master's course "Electronics and Control System" is described as having the following learning outcomes:

LO1. Explain the principles of construction of devices of automated control systems, in order to determine their function and characteristics of structural units of power, digital devices and electronic sensors;

LO2. Apply methods of designing nonlinear adaptive systems and neural networks to create intelligent control systems using deep machine learning mechanisms;

LO3. Design embedded systems using modern digital integrated circuits for use in control units of intelligent and multi-agent systems.

LO4. Use modern digital data transmission systems to create wired and wireless communication channels using Internet of Things technology and sensor networks in automated control systems;

LO5. To develop power and electronic functional blocks of control systems of embedded systems, to characterize their structural modules, to ensure uninterrupted communication between them for remote control and monitoring in real time using Internet of Things technology;

LO6. Analyze the applicability of intelligent systems using neural networks and machine learning methods for data processing in order to improve the efficiency of the technological process;

LO7. Solve problems related to the creation of automated dispatch control and monitoring of data from the sensor system using modern technologies of various data transmission technologies, using the Internet of Things;

LO8. To determine the key features and functional characteristics of the adaptive automated control systems being developed based on neural networks in order to optimize the technological process;

LO9. To demonstrate a high level of competence in the development of project documentation, educational and methodological complexes, to determine the goals and methods of solving analytical and technical problems in the field of automated control systems;

LO10. Integrate the skills and abilities of designing and developing electronic and power devices to create hardware and software for intelligent control systems;

LO11. Evaluate adaptive and nonlinear methods used in embedded control systems, identify advantages and disadvantages in the operation of these systems in order to improve the existing system;

LO12. Demonstrate a civic and ideological position, formulate problems, goals, tasks in the theoretical and practical spheres of management systems, work with foreign scientific and technical literature, participate in international cooperation in the field of professional activity, be able to organize the work of scientific and technical personnel, use an individual approach to students in the implementation of pedagogical activities in the field of electronics and control systems.

Lastly, the PhD programme "Automation and the Internet of Things" addresses an interdisciplinary approach to the two eponymous subjects of the program. Its aims are focused on scientific research and writing. The university describes the learning outcomes as follows:

ON1. Demonstrate an interdisciplinary understanding of the concepts of modern automatic regulation and control systems, the role of the Industrial Internet of Things in improving the productivity of technological processes.

ON2. Analyze, evaluate and select elements, methods and standards of modern control systems, architecture of microcontroller devices, software tools for the purpose of their further application in the development of large-scale engineering control systems.

ON3. Apply microcontroller technology in manufacturing industries, design and develop IoT applications and services adapted to the industrial needs of "Industry 4.0".

ON4. Build mathematical models of optimal control, analyze the controllability and observability of systems, design fuzzy control systems and control systems based on artificial neural networks.

ON5. Design and prototype IoT devices based on microcontrollers and PID controllers using intelligent control methods.

ON6. Critically evaluate and predict the ways of development of automation and control of complex technical and socio-economic control objects in the form of formalized mathematical and computer control models.

ON7. Propose new hypotheses and solutions to scientific problems in the field of design and development of intelligent automated control systems based on an independent original approach; contribute to the development of society.

ON8. Build a research process on the topic of the dissertation, present and discuss the results of research in oral and written form at national and international scientific conferences, in scientific discussions and publications in national and international peer-reviewed publications.

All in all, the six degree programs presented here convinced the experts in regard to their academic qualification level. The experts trust that the competences to be acquired in the respective programs reflect the respective degree.

This was not apparent from the evidences as – especially in regard to the Bachelor's programmes – fundamental knowledge appears missing. To give an example, there appears to be a lack of programming courses and of instructions about "Signals and Systems" for the Bachelor's programmes "Intelligent Control Systems" and "Industrial Electronics and Control Systems." During the discussions, however, these discrepancies could be explained away as either mismanaged translations or a different focus within the programs. The programming courses were titled "Algorithmization", and hence were present under an unsuspected name; And the basics of "Signals and Systems" were taught throughout the modules, e.g., in "Linear automatic control systems."

The six programs were developed with the students' prospective position in the labor market in mind, as is evident from the government project "Digital Kazakhstan." The project's course of action is to progress the digitalization of the country, for which about 100,000 qualified workers are to be educated as IT specialists. The university employs stakeholders as teachers (by governmental decree), so representatives of the labor market are directly involved in both teaching and developing the courses. The experts agree that the involvement of stakeholders is sufficient to guarantee that the programs are adapted to changes in the labor market, if necessary.

As for the learning outcomes of the programs, the experts found that they did not meet the expectations fully. For one, the English translation was lacking in several instances which hampered comprehension. The second learning outcome of the PhD program "Intelligent Control Systems," for example, contains the phrase "theory of extreme tasks," which is most likely a mistranslated piece of jargon.

According to the experts, the learning outcomes of the programs are lacking in definiteness. This is especially the case for differentiating between the expected competences of Bachelor's and Master's graduates: Here, the expected learning outcomes need to be more contrastive to stress the different goals of Bachelor's and Master's graduates. The experts agree that these flaws must be addressed: The learning outcomes should be reworked in a way that guarantees comprehension in every language provided. Furthermore, they should represent the goals of each degree program concisely.

Criterion 1.2 Name of the degree programme

Evidence:

- Self-assessment report
- Diploma supplements

- Discussion during the audit

Preliminary assessment and analysis of the peers:
KazNU awards a “Бакалавр техники и технологий”, Bachelor of Engineering and Technology, to the graduates of the Bachelor’s degree programmes “Industrial Electronics and Control Systems” and “Intelligent Control Systems.” The university awards a “Магистр технических наук”, Master of Engineering Sciences, to the graduates of both Master’s degree programmes “Electronics and Control Systems” and “Intelligent Control Systems”. Finally, a “доктор философии”, a doctor of philosophy, to graduates of the two PhD programmes “Automation and the Internet of Things” and “Intelligent Control Systems.”

The peers confirm that the English translation and the original Russian name of all degree programmes correspond with the intended aims and learning outcomes as well as the content of the respective degree programme. The name of the three degree programmes “Intelligent Control Systems” was changed from “Automation and Control”. This was a response to a recommendation made during the first accreditation procedure in 2017 about structure and content of the programmes. In their self-assessment report it says that the name change is a response to “the increasing role of intellectualization of the processes of automation and control” (p. 17).

Criterion 1.3 Curriculum

Evidence:

- Module Handbooks
- Self-Assessment Report
- Discussion during the audit

Preliminary assessment and analysis of the peers:
The six degree programmes under review are implemented by the Faculty of Information Technology at Al-Farabi Kazakh National University. All courses are offered in the languages Russian, English, and Kazakh. Some courses, e.g., foreign language courses, are exempted from this. The students pick their preferred language of instruction in the first semester and the teaching staff accommodates these wishes, as soon as a certain threshold of students is reached. The university incentivizes the usage of English as the language of instruction, especially at the higher academic levels. Teaching staff is required to provide a proof of proficiency at a B2 level (according to the CERF). The test results for the English proficiency was shown to the experts during the audit.

Generally, the curricula provided for the six degree programs do not pose any issue. The modules, at times, might have a focus that is described by the expert panel as “unusual”; However, the programs do cover all cornerstones that are specified in the learning outcomes in terms of content. Furthermore, the basics needed for each course of study are anchored well into each program.

In terms of structure, the programs are equally as sound. On the Bachelor’s and Master’s level, the students first learn general concepts of their field of study as well as basics of humanities, such as sociocultural subjects and a foreign language. Then, the modules become more specified or technical. Each program ends with a “Final Attestation” where students defend a written thesis. The progression is overwhelmingly logical and, according to the experts, achievable for all programs.

The panel remarked, however, that the system appears rather rigid. There are many compulsory courses with few opportunities for the students to choose specializations on their own accord. A higher degree of freedom would help students to specialize more individually in their respective fields of study.

The PhD programmes have a clear focus on research, central issue being the doctoral thesis, research seminars and research practice. In the first semester, the PhD students are offered courses, both in scientific work and in their fields of study. A part of these courses being compulsory had the experts wondering about a lack of interdisciplinary research: The courses are consolidating the very field of study in either programme and thus might take away the opportunity for students to choose more freely the courses that might fit best the aim of their doctoral thesis. During the audit the university explained that the government of Kazakhstan has established there to be a certain number of obligatory courses (among them academic writing). However, that does not justify the need for obligatory courses with technical content.

In regard to both the overall content and structure, one of the greater issues with the material was the translation. The module handbooks were in part not translated at all or lacked an unambiguous expression. It was strenuous at times to understand either contents or learning outcomes of some modules. During the audit, the parties responsible at KazNU could demonstrate that the structure and the content of each programme was well thought out and did not have issues that went beyond the surface of mistranslation. In the following there is a list of module names that are unfitting or misleading due to their translation:

- “Foreign language” (depending on whether the program is actually intended to teach more languages than English)
- “Educational practice” are laboratory courses that sound like teaching courses

- “Information and Communication Technologies” is misleading because the technologies are not taught, but rather how they are used. Suggestion: “(Utilizing) Information and Communication Tools”.
- “Introduction to Blockchain Technologies” is about Ethereum and smart contracts and should, thusly, be named “Introduction to Ethereum Blockchain Technologies”.
- “Professional (Pre-Diploma) Practice” should be renamed “Diploma Preparation”.
- The contents of the module “Process Simulation Modelling” are not represented well by its name. An alternative would be “Electric Circuits for Sensing Applications”.
- “Electrical Engineering” is far too general a title as well as misleading. “Fundamentals of Electrical Engineering” is more fitting.
- “Conversion Techniques” is misleading. It should be renamed “Electrical Power Conversion” to exclude readings of analog/digital conversion.
- “Electronic and Optoelectric Devices” has a misleading name that should be changed to “Electronic and Optoelectric Components”.
- “Algorithmization” in the context of “Algorithmization and Programming” should be called “Computer programming”.
- “Machine Learning and Artificial Intelligence” is too far-fetched. It should be renamed “Basics of Machine Learning” to better reflect the contents.
- “Signal Coding and Processing” is misleading. It should be renamed “Channel Coding”.
- “Optimal Control of Automation Systems” does not fit the contents in the module handbook. There was probably a copy-and-paste error.
- “IoT Design Systems” should rather read “IoT System Design”.
- “Teaching Internship” appears misleading and should better be called “Pedagogical Practice”.
- The course “Power Devices and Systems” should be titled, e.g., “Power Electronic Devices and Systems” to disambiguate from courses on mechanical engineering.
- The modul “Higher Mathematics” appears in both bachelor programs, but its content in the one program differs strongly from its counterpart in the other one . These differences should be visible in the names of these actually two different modules.

A special case for in terms of module titles was module M-5 for the Bachelor’s degree program “Intelligent Control Systems.” This module is titled “Differential equations and Digital Electrical Engineering” and tries to conjoin two theoretical foundations of the program that do not have any logical connection. It is recommended to split this module into two.

Despite this lack in clarity – that needs to be addressed by the university – the experts are convinced that the structure and contents of all programs are well developed.

Student mobility

KazNU as a university has a great interest in internationalization. As of 2023, there exist bilateral agreements and cooperation agreements with 550 universities in 50 countries. In 2022, KazNu opened branches in Istanbul, Turkey, and in Bishkek, Kyrgyzstan. There are further plans to open branches in Tashkent, Uzbekistan, and Moscow, Russia. Currently, there are 2973 international students (about 12 %) studying at KazNU.

The faculty of Information Technology offers several programs to promote academic mobility. For one, there are funds provided by the Ministry of Education of Science of the Republic of Kazakhstan as well as international exchange programs such as Erasmus+. Additionally, there are possibilities for scientific internships and summer schools at universities in Russia, Poland and Germany. In a discussion with students the experts found out that the students did know about the exchange programs and how to get more information on them; However, none of the undergraduate students had actually studied abroad or had tangible plans to do so. This might be owed to the COVID-19 pandemic which obviously brought student mobility to a halt. As of now, it appears that the information given by the university about exchange programs is quite scarce. In the future, there could be events on campus in order to get students interested in taking part in exchange programs.

Periodic Review of the Curriculum

The curricula of all programmes are regularly reviewed. During these reviews the coordinators of the programmes take into account student opinions and feedback; Thus, the staff responsible keeps in mind the structure of the modules – both internally and within the programs – to guarantee that the programs can be studied. The experts did not find any issues with this system.

Criterion 1.4 Admission requirements

Evidence:

- Self-assessment Report
- Module Handbooks
- Discussions during the audit

Preliminary assessment and analysis of the peers:
In order to apply for a Bachelor's programme in Kazakhstan, prospective students need to take part in a Unified National Testing (UNT). This testing is performed throughout the country when graduating from school. The result of the UNT is the basis for acceptance to

any university. The threshold score for acceptance is determined by each university. Currently, the score necessary to be accepted at KazNU amounts to 90 out of 145. For international students it is necessary to apply with a standardized testing score (such as SAT) to convert the scores.

To apply for Master's and PhD programmes, interested students must first register in a mobile database and create a "digital passport". Prospective PhD student must, additionally, attest at least nine months of working experience. Applications are overseen by a University Admissions Committee. The exact requirements for admission differ from program to program. For those four programs under review here, the deciding factor for admission is the GPA of the Bachelor's degree, or Master's degree, respectively. The threshold is decided by the university for each programme. If a certain education at another university is not deemed sufficient for postgraduate programmes, it is possible to study the lacking disciplines after enrolment on a paid basis.

The admission requirements are published on the university website which informs potential students in detail about the requirements and the necessary steps to apply for admission into the programs. Since the rules are based on official regulations, the auditors deem them binding and transparent. They confirm that the admission requirements support the students in achieving the intended learning outcomes.

Criterion 1.5 Workload and Credits

Evidence:

- Self-assessment report (SAR)
- Module handbooks
- Survey of student satisfaction related to the workload
- University Website: https://www.kaznu.kz/en
- Discussions during the audit

Preliminary assessment and analysis of the peers:
KazNu uses a credit system for assessing the workload of students which is valid for all modules of the educational programs. The amount of credits awarded for every module is based on the respective workload. The workload includes contact hours and time for independent work. As stated in the SAR, one academic credit (ECTS) is equivalent to 30 hours, of which at least 9 to 10 hours are devoted to contact classroom work of students. The

Bachelor's programmes are comprised of 240 ECTS, the Master's degree 120 ECTS and PhD doctoral programmes 180 ECTS.

The course structure of both Bachelor's degree programs, "Intelligent Control Systems" and "Industrial Electronics and Control Systems" has an overall similar composition. The 8-semesters (4-years) programs are comprised of "General Education Disciplines," "Core Disciplines," and "Major Disciplines." These three branches are further divided into obligatory courses and electives. Both programs stipulate a workload equivalent to 240 ECTS. The modules are structured in a way that balances the workload in each semester to approximately 30 ECTS; the lowest workload in either course is the last semester with 24 ECTS, the highest is 36 ECTS.

The master's degrees are programs of four semesters (two years) time that award 120 ECTS total. Both programmes consist of 24 ECTS of "Research" – i.e., education about academic writing and handling an individual dissertation –, as well as "Core Disciplines" and "Major Disciplines". Those two disciplines are further divided into mandatory courses and electives. The first and forth semester have a workload of 27 ECTS each; The remaining two consist of 33 ECTS.

The two PhD programmes, "Automation and the Internet of Things" and "Intelligent Control Systems," are comprised of a 3-year (6-semester) course structure with a workload equivalent to 180 ECTS. 123 ECTS of the whole workload is reserved for "Research," which consists of the writing of the doctoral thesis (59 ECTS) as well as research seminars and participation in conferences. The remaining credit points correspond to compulsory and elective courses, also divided into "Core Disciplines" and "Major Disciplines."

The experts found that the structure of each program is well balanced and avoids peaks in the workload of students. The students interviewed during the audit were also content with the balance of the workload both throughout the study program but also in their schedules. In the Bachelor's degree program "Intelligent Control Systems" there is one module, M-11, that awards 27 ECTS and could easily be split up into two or even three modules. The experts assume that this would fit much more neatly with the usually smaller modules.

Criterion 1.6 Didactic and Teaching Methodology

Evidence:

- Self-assessment report (SAR)
- Module handbooks

- Discussions during the audit

Preliminary assessment and analysis of the peers:
According to the self-assessment report, KazNU applies a various number of didactic measures. Among those are lectures, laboratory courses, seminars, as well as research studies. Lectures provide the students with a solid foundation of knowledge in the disciplines. In the seminars students are offered a more collaborative approach to questions and problems. They may work on and present projects they make individually or in small groups and have discussions. The students take part in laboratory courses in order to experience a hands-on approach to the theory they learn. The university offers several research labs with gadgets and devices that demonstrate fundamental principles of their fields of study. The students are allowed to use these labs to work on their own accord with materials provided by the university.

Students at the Master's and PhD levels are also encouraged to teach themselves to help them to consolidate the knowledge they already acquired and to gain a new perspective on the learnt subjects. Furthermore they take part in conferences as part of the course work which helps with networking, soft skills, and scientific work.

These various teaching methods are also provided in the module handbooks of the courses under the designation "teaching methods."

Just as the curricula, the teaching methodology is regularly reviewed by the teaching staff, taking into account the input of all stakeholders. The expert panel did not find any issue with the didactics and teaching methods employed in the programs under review.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 1:

First of all, regarding the learning outcomes, KazNU states in their response that the expected results of the undergraduate and graduate studies have been changed in a way to reflect more clearly the objectives of the programmes. In doing so, they want to describe the master's programmes to be focused on in-depth knowledge of the respective subjects and research. The representatives have begun steps to update the two Bachelor's and two Master's programmes as per government regulations on the National Platform of the Unified Management System for Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan.

KazNU sees the general need for revising the documentation in respect to mistranslations and technical errors during compilation. According to their response, they have already managed to correct the faulty documents to ensure a clean translation.

The titles of the modules that might have contained misnomers have been revised as follows:

For the Bachelor's programme Industrial Electronics and Control Systems:

- the name of the discipline "Algorithmization and Programming" was changed to "Computer programming".
- the name of the discipline "Machine Learning and Artificial Intelligence" was changed to "Introduction to machine learning and neural networks".
- the name of the discipline "Signal Coding and Processing" was changed to "Channel Coding".
- the name of the discipline "Higher Mathematics" was changed to "Engineering Mathematics".
- the name of the discipline "Conversion Techniques" has been changed to "Electrical Power Conversion".
- The module name "Electronic and Optoelectric Devices" has been changed to "Electronic and Optoelectric Components".

For the Bachelor's programme Intelligent Control Systems:
- the name of the discipline "Introduction to Blockchain Technologies" was changed to "Introduction to Blockchain". Accordingly, changes were made to the content of the module.
- the name of the module "Electrical Engineering" has been changed to "Fundamentals of Electrical Engineering".
- the discipline "Differential Equations" is merged into one module with the discipline "Optimization methods and numerical methods". Module name changed to "Advanced Mathematical Techniques for Engineering".
- the name of the discipline "Process Simulation Modeling" was changed to "Internet of Things and Product Lifecycle Management".
- the name of the module "Higher Mathematics" has been changed to "Fundamentals of Mathematics and Physics for Engineers".

For both Bachelor's programmes:

- the name of the practice "Professional (Pre-Diploma) Practice" has been changed to "Diploma Preparation".

For the Master's programme Intelligent Control Systems:

- the name of the discipline "Teaching Internship" was changed to "Pedagogical Practice".

- the name of the discipline “Power Devices and Systems” was changed to “Power Electronic Devices and Systems”.
- in the description of the discipline “Optimal Control of Automation Systems”, technical errors related to translation have been fixed. Corrections have been made to the module handbook.
- the name of the discipline “IoT Design Systems” was changed to “IoT System Design”.

As for the modules titled “Foreign language” in the Bachelor’s programmes, KazNU explained that the language taught is not necessarily English, which is why the the name of the module was chosen accordingly.

Lastly, the undergraduate discipline “Information and Communication Technologies” has not been changed by the representatives of KazNU. It is, according to them, a compulsory discipline introduced by the Ministry of Education and Science of the Republic of Kazakhstan. The experts opine, though, that this explanation is insufficient in respect to the issue at hand: The title does not match the content. Either the title or more precisely the word “technologies” is a mistranslation and should rather be “tools” or “techniques,” or the content needs to be revised.

As for the size of module M-11 in the Bachelor’s degree programme “Intelligent Control System,” KazNU agrees that this module can be split into two and have decided to divide it accordingly.

All in all, the experts support the university in rectifying their translation, correcting the mismatches between titles and content of the modules, and in splitting up the large module. Since changes of this magnitude take time, the actual evidence (i.e., the revised module handbooks, information on the website) could not yet be provided. This is why the respective requirements and recommendations need to be maintained (A1; E1, E3, E4).

2. Exams: System, Concept and Organisation

Criterion 2 Exams: System, concept and organisation

Evidence:

- Academic Policy (https://www.kaznu.kz/content/files/pages/folder20484/Academic%20policy.pdf)
- Module Handbooks

- Samples of students' work (projects, exams and thesis)
- Discussions during the audit
- Preliminary assessment and analysis of the peers
- Self-assessment report
- Discussions during the audit

Preliminary assessment and analysis of the peers:
The degree study programs under review here follow the examination rules as stated in the Academic Policy of KazNU. Examinations may takes several forms, among them written and oral examinations (either in-situ or online), but there are also reports, presentations, and group projects. The examination form for each module is regulated in the module handbook and published in greater detail in the university's online "univer" system.

The university applies a 100-point scale (percentages) as a standard assessment method. An examination is considered passed when at least 50 % is answered correctly. The general grading system and its conversions into letter grades and GPA is taken from the self-assessment report (p. 36) and illustrated below:

Letter grade	Grade Point Value	Percentage	Conventional Grade
A	4.0	95-100	Excellent
A-	3.67	90-94	
B+	3.33	85-89	Good
B	3.0	80-84	
B-	2.67	75-79	
C+	2.33	70-74	
C	2.0	65-69	Satisfactory
C-	1.67	60-64	
D+	1.33	55-59	
D	1.0	50-54	
FX	0.5	25-49	Failure
F	0	0-24	
I (Incomplete)	-	-	"Incomplete" (not included in your GPA calculation)
AU (Audit)	-	-	"Audit"(not included in your GPA calculation)
Cert.	-	30-6050-100	"Certification"(not included in your GPA calculation)

Uncert.	-	0-290-49	"Uncertification" (not included in your GPA calculation)
R-difference	-	-	"Discipline difference on curriculum" (not included in your GPA calculation)

For each module, KazNU employs three means of testing to assess whether learning outcomes are achieved: "Current control" is a systematic testing of knowledge according to the syllabus and basically a weekly assessment. It may include homework and activity in the classroom. "Mid-term controls" are two tests carried out by the seventh or 15th week of an academic year, respectively. The "final control" is the final examination that takes place after the courses are finished. The exam is carried out within a time frame of two weeks after the lectures, but there may only be one exam per day. In order to be admitted to the final control the students need to achieve an average of 50 in the two mid-term controls. The final grade of a module is determined via the formula *(MC1 + MC2) / 2 x 0.6 + (FE x 0.4)*, where MC is "mid-term control" and FE is "final examination".

When a student receives at least 25 % but does not pass the exam (grade FX) they may re-take the exam on a paid basis. For any lower score the student needs to re-take the whole course or module on a paid basis. The same holds true for FX grades for which the exam is not re-taken in due time.

The final examination of each program is writing and defending a thesis (called "Final Attestation"). This is an obligatory module.

When sighting the thesis samples provided by KazNU, the experts could ensure that the academic performance and the contents of the modules are sufficient for the respective programs. They could also make sure that online examinations are supervised with the current technology to prevent cheating. Furthermore, they ascertained that the number and distribution of the exams is adequate in terms of workload and preparation. The students remarked, however, that syllabi might not be completed by the beginning of the semester so that the exact time or form of the exam is not known soon enough. The faculty has to make sure that information about exams are given in due time.

3. Resources

Criterion 3.1 Staff and Development

Evidence:

- Self-assessment report
- Staff handbook

Preliminary assessment and analysis of the peers:
According to the faculty, KazNU requires professors to have a PhD, to have broad experience in research activities, and to have publications in considerable journals. Personnel is selected on the basis of an open competition for vacant position during the summer period. During this process aforementioned achievements are taken into account next to soft skills such as communication and team competencies.

In the staff handbooks, the capacities of the teaching personnel is described as follows: For the Bachelor's degree program "Intelligent Control Systems" there are 33 teachers in total; for the respective Master's degree program there are designated 13 teachers; and for the PhD program there are six. The Bachelor's degree program "Industrial Electronics and Control Systems" attests 29 teachers; The Master's program "Electronics and Control Systems" does 13. Finally, for the PhD programme "Automation and the Internet of Things" there are eight designated teachers. The handbooks also provide ample proof about the teachers' education and involvement in scientific projects.

According to the program coordinators, the teaching staff can, on their own terms, choose whether to invest more time into research or into teaching. The teaching staff likes how the university encourages involvement in scientific projects. They receive sufficient funding to attend conferences and for other projects.

The university also offers programs to improve didactic skills. For one, the academic process starting at the Master's level involves pedagogics as a teaching matter. Master's students and PhD students are expected to teach, so they gather didactic experience early on. Furthermore, the Institute for Advances Studies offers various activities for teachers to improve their didactic skills.

In general, the teaching personnel voiced satisfaction with their employment at KazNU. They described that, with a PhD position, they receive attractive salaries and are encouraged to attend internships in other countries, e.g. in Europe or the USA.

All in all the experts could gather that the teaching staff is appropriate for all programs.

Criterion 3.2 Funds and equipment

Evidence:

- Visitation of the university and laboratories
- Self-Assessment Report (SAR)
- Discussions during the audit

Preliminary assessment and analysis of the peers:
According to the self-assessment report, the university provides for all necessary equipment on an annual basis. This includes office supplies, laboratory equipment, and other materials. The campus has sufficient classrooms for the amount of students. There are several laboratories with various emphases to teach a hands-on approach to the theory the students learn in their lectures.

These laboratories were demonstrated during the audit. The experts could convince themselves that the equipment provided to the students is wholly sufficient for teaching the programs.

4. Transparency and documentation

Criterion 4.1 Module descriptions

Evidence:

- Self-assessment report
- Module handbooks
- Discussions during the audit

Preliminary assessment and analysis of the peers:
Each of the six degree programs under review comes with its own module handbook. In it, there is a study course plan for the whole program in which the modules are arranged according to the semester in which they are to be taken. Then a listing of all modules follows. These modules are further divided into courses.

Each module has its own tabulation in which are displayed the module title, the awarded credit points, the semester in which the module is taught, whether the module is elective or mandatory, the teaching methods involved as well as the workload in hours and in ECTS. Furthermore, the module description lists the person responsible for the module, the language of instruction, prerequisites and post-requisites, the intended learning outcomes,

contents and the examination forms. At last, modules contain a reading list with recommended literature for a module. The module handbooks are color-coded in accordance with the disciplines mentioned above.

The module handbooks do have a convincing structure in general, however, the contents are lacking in several regards. For one, as was already listed above, many titles suffered from mistranslations. This is a great drawback to cohesiveness between module title and actual teaching matter. The mistranslations within the module handbooks also emerge in both the module objectives and in the contents. This is especially serious when it comes to jargon that needs a precise denomination. The module handbooks have to be retranslated lest they be, at times, incomprehensible. Furthermore, there are instances in which the module title does not fit the contents or learning outcomes altogether. During the audit the experts could elicit that there were some parts of a module erroneously pasted elsewhere. It must be ensured that all modules are correctly displayed in the handbooks.

In some of the modules there are pieces of information missing from the handbook. This concerns, e.g., the person responsible for the module, a reading list, or contents. The module handbook must be presented in full with all information readily available.

Another problem arises from the prerequisites and post-requisites. At times, the exact knowledge required to take part in module is not fathomable from the module handbook. For example, one of the prerequisites for the course “Simulation Models for Designing «Industry 4.0» Solutions” is listed as “Physics 1, 2”. The exact contents of these physics courses are not further elaborated. Apart from vague descriptions, there are also instances where the prerequisites cannot be fulfilled logically. For example, in the Master’s degree program “Intelligent Control System” there is a course “Tools for Automating Business Processes in Production” that is taught in the first semester. It lists as a prerequisite the course “Software and Hardware for IoT”, which is taught only in the second semester. These discrepancies must be eliminated so that the prerequisites and post-requisites for each module are, for one, meaningful in their description, and further logically concatenated.

At last, the module handbooks could not be found on the KazNU website in the form they were presented to the experts. A streamlined version is available but it excludes several of the contents to be displayed.

To summarize, the module handbooks need to be filled out completely, be retranslated and be checked thoroughly for logical inconsistencies. Then, the reworked module handbooks are to be published on the university website to be consulted both by people affiliated with the university and by interested third parties.

Criterion 4.2 Diploma and Diploma Supplement

Evidence:

- Samples of diploma supplements
- Self-assessment reports
- Discussions during the audit

Preliminary assessment and analysis of the peers:
The university supplied the experts with diplomas, diploma supplements, and transcripts of record. The diplomas are offered in Kazakh or Russian and in English. They contain information about the degree awarded and the name of the program. The diploma comes with a transcript of records in two languages in which are stated all modules taken by a student, the credits awarded, and the grades they achieved. The grades are offered as a letter mark, a GPA and a conventional mark as listed above.

The diploma supplements are offered in English and contain information about the student, the degree and field of study, and the language of instruction. The level of qualification is stated with the amount of ECTS acquired as well as the access requirements for the program. Finally, the diploma supplement outlines the learning outcomes of the study program and the grading system.

The expert panel did not have any issue with the documentation provided.

Criterion 4.3 Relevant rules

Evidence:

- Self-assessment report
- Discussions during the audit

Preliminary assessment and analysis of the peers:
The university has published an academic policy on their website in which rules and guidelines are explained. The document is offered in Russian, Kazakh, and English, and covers subjects from the admission and exam structures to the graduation or expulsion of students. Further information on courses is also offered via univer or in the syllabus.

The students did not voice any concerns about the access to rules and regulations at KazNU.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 4:

The representatives of KazNU have noted the existing issues with the modules handbooks. As mentioned in 1., this is partly due to mistranslations or technical errors during compilation. KazNU has begun to check the handbooks for missing information and further mistranslations. Moreover, inconsistencies regarding the prerequisites and post-requisites have been eliminated to guarantee consistency and a cohesive structure of the modules. The university will publish the reworked module handbooks on their website.

The experts welcome this course of action. Until the changes to the module handbooks are verified and published, the current requirements must be upheld (A2, A3).

The expert team regards this criterion partially fulfilled.

5. Quality management: quality assessment and development

Criterion 5 Quality management: quality assessment and development

Evidence:

- Self-assessment report
- Samples of surveys
- Discussions during the audit

Preliminary assessment and analysis of the peers:
The university ensures a periodical internal quality assurance. To do so the academic staff, employers, and students analyse evaluate the educational programs annually as well as every three to five years.

The annual analyses are concerned, foremost, with the needs, requirements, and satisfaction of the students with the programs. To do so, they review the workload of the students, the effectiveness of the assessment procedures, the conditions of the instruction at the university as well as the support services offered. The programs are further analysed in terms of scientific, social, and economical developments or trends to adapt the programs accordingly. The situation on the labor market is considered further by prospective employers taking part in both designing and implementing new study programs. For the cyclic

monitoring – i.e., every three to five years, depending on the length of a study program – the quality management takes into account the results of the whole study program.

Additionally, at the end of each semester the students evaluate courses in terms of teaching methodology and staff in the form of questionnaires. Here, the expert panel found out that the students' opinions were overwhelmingly positive. It turned out that the university link the evaluation process to access to the grades: Students are allowed to look at the grade of any course only after filling out a questionnaire. It stands to reason that students will not take their time to do a questionnaire in earnest in this situation. What is more, the survey is, according to the experts, too late to enable a discussion between students and teaching staff. The experts recommend that the questionnaire should be filled out before the semester ends to allow for more sincere responses and the opportunity to close the feedback loop between teachers and students.

Apart from that the experts were content with the internal quality management as provided here.

D Additional Criteria for Structured Doctoral Programmes

Criterion D 1 Research

Evidence:

- Self-assessment report
- Module handbook
- Discussions during the audit

Preliminary assessment and analysis of the peers:
KazNu structures their PhD programs in a way that enables doctorate students to do research on an appropriate level. For one, the university educates their students in a way that helps them to do independent research and also to present their findings, both verbally and in written form.

For the independent research, the university provides two specialized laboratories to provide students with equipment to work in their fields. The students are expected to link their dissertations to research they do in these labs. The programs are structured in way that helps them to perform academic research and scientific writing in the form of mandatory courses in the first semester. Doctoral students give presentations about their research

results at KazNU to acquire skills of public speaking and leading discussions. Students are further encouraged to participate in national and international conferences.

The expert panel is convinced that the education of the doctoral students is at an appropriate level.

Criterion D 2 Duration and Credits

Evidence:

- Self-assessment report (SAR)
- Module Handbook
- Academic Policy
- Sample of Dissertations
- Discussion during the audit

Preliminary assessment and analysis of the peers:
The two PhD programs under review here operate within three years (six semesters). Students receive a theoretical training of 45 ECTS. The remaining 135 ECTS for a program are planned individually with a supervisor. The plan includes the research and research work, the structure of the dissertation, a timetable for writing the dissertation, as well as possibilities for scientific publications.

For the PhD programs the expert panel expressed qualms about the mandatory courses. The university explained that these courses are prescribed by the government, necessary for PhD programs. The amount of these mandatory courses has, according to the university, already decreased over the last years.

Criterion D 3 Soft Skills and Mobility

Evidence:

- Self-assessment report (SAR)
- Module Handbook
- Academic Policy
- Discussion during the audit

Preliminary assessment and analysis of the peers:
As was already mentioned the students of these PhD programs are trained in both scientific writing and speaking. The speaking part includes the presentation of academic results to increase the familiarity with public speaking, moderating discussions as well as coping with academic controversy or dissent.

Students are also encouraged to go abroad for either conferences, internships or studies. For the PhD program "Intelligent Control Systems" two students went abroad for at least one month to Russia and Turkey, respectively; Two students came to KazNU for more than one month. Academic mobility is not only promoted by the university; There are also government programs by the Ministry of Science and Higher Education.

Additionally, PhD students are encouraged to teach classes themselves during their study program.

All in all, the experts deem the mobility of the students appropriate.

Criterion D 4 Supervision and Assessment

Evidence:

- Self-assessment report (SAR)
- Academic Policy
- Discussion during the audit

Preliminary assessment and analysis of the peers:
The doctoral students are consulted by two professors, one of whom is a scientist from another university. The consultants and the topic of the dissertation are reviewed and approved by the Academic Council of the faculty, the Academic Council of the University and the Rector. The consultants guide the students in terms of development of their work. They are responsible for the schedule of the individual PhD program and they must create all necessary conditions for the research work of the students.

The expert panel is convinced that the supervision and assessment of the PhD students in both programs is transparent and appropriate.

Criterion D 5 Infrastructure

Evidence:

- Self-assessment report (SAR)

- Academic Policy
- Discussion during the audit

Preliminary assessment and analysis of the peers:
KazNU offers the PhD students well-equipped laboratories which they can use independently. The supervisors are responsible for access to equipment that is needed to conduct research at KazNU.

In the last couple of years, KazNU has broadened their access to e-books and journals. Had the library earlier included documents mostly in Russian, it does now offer international publications in English. In particular, it now provides free access to the highly renowned journals of the IEEE. In near future, though, the students will need to pay a nominal fee for that.

The experts see the infrastructure of the university has improved and been internationalized over the last years. They consider the infrastructure adequate for the PhD programmes under review here.

Criterion D 6 Funding

Evidence:

- Self-assessment report (SAR)
- Academic Policy
- Discussion during the audit

Preliminary assessment and analysis of the peers:
Doctoral students at KazNU have to initially compete to receive grant funding for their scientific and technical projects. These grants are issued by the Ministry of Science and Higher Education of the Republic of Kazakhstan. To enrol in one of the PhD programs, the students need to successfully obtain a grant funding in order to conduct their studies and research. Additional grants are offered the Yessenov Scientific and Educational Foundation, the Abay-Vern scholarship program or international grants such as Erasmus+.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion D 6:

[…]

Criterion D 7 Quality Assurance

Evidence:

- Self-assessment report (SAR)
- Academic Policy
- Discussion during the audit

Preliminary assessment and analysis of the peers:
As a state university, KazNU follows the rules and regulations for doctoral studies in the Republic of Kazakhstan. the Office of Academic Affairs and the Department of training and certification at KazNU oversee all doctoral programs. Admission to doctoral studies is carried out in accordance with the Rules for Admission to Education in Educational Organizations Implementing Educational Programs of Higher Education and Postgraduate Education. The preparation of doctoral students is carried out within the framework of the state educational order and on the basis of contracts for the provision of educational services for a fee, concluded between the university and the customers of educational services.

During their studies, doctoral students have to closely follow the guidelines developed with their supervisors as the study at KazNU requires a timely and efficient performance. These guidelines and regulations are published on the website of KazNU.s

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion D 7:

[…]

E Additional Documents

Before preparing their final assessment, the panel ask that the following missing or unclear information be provided together with the comment of the Higher Education Institution on the previous chapters of this report:

No additional documents needed

F Comment of the Higher Education Institution (30.05.2023)

The following quotes the comment of the institution, whereby the parts in italics represent sections taken from this report:

Criterion 1.1 Objectives and learning outcomes of a degree programme (intended qualifications profile)

Comment. As for the learning outcomes of the programs, the experts found that they did not meet the expectations fully. For one, the English translation was lacking in several instances which hampered comprehension. The second learning outcome of the PhD program "Intelligent Control Systems," for example, contains the phrase "theory of extreme tasks," which is most likely a mistranslated piece of jargon.

Response. Information omitted from some items in the self-assessment report, modular catalogue, staff handbook, supplemented after careful review. Technical errors that occurred when translating the text of the report into English were eliminated after verification.

Comment. According to the experts, the learning outcomes of the programs are lacking in definiteness. This is especially the case for differentiating between the expected competences of Bachelor's and Master's graduates: Here, the expected learning outcomes need to be more contrastive to stress the different goals of Bachelor's and Master's graduates. The experts agree that these flaws must be addressed: The learning outcomes should be reworked in a way that guarantees comprehension in every language provided. Furthermore, they should represent the goals of each degree program concisely.

Response. Changes have been made to the description of the expected results of undergraduate and graduate studies in professional skills in order to more clearly reflect the goals, the specifics of undergraduate and graduate programs, to show that at the master's level in-depth knowledge is given in the subject, training is focused on research and strengthening the skills of analysis and synthesis . At the same time, Dublin descriptors were used, which determine the level of knowledge and skills of students by level of training. More clearly defined learning outcomes will allow a clear understanding of the goals and objectives of the educational program.

After the work done, in accordance with the recommendations received from the ASIIN Agency, we have submitted applications for updating the Bachelor's program "Industrial

Electronics and Control Systems", Master's program "Electronics and Control Systems", Bachelor's and Master's programs "Intelligent Control Systems (Automation and Control)" in on the National Platform of the Unified Management System for Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan (http://esuvo.platonus.kz/#/).

Criterion 1.3 Curriculum

Comment. In regard to both the overall content and structure, one of the greater issues with the material was the translation. The module handbooks were in part not translated at all or lacked an unambiguous expression. It was strenuous at times to understand either contents or learning outcomes of some modules. During the audit, the parties responsible at KazNU could demonstrate that the structure and the content of each programme was well thought out and did not have issues that went beyond the surface of mistranslation. In the following there is a list of module names that are unfitting or misleading due to their translation:

Response. Comments related to the translation of names and descriptions of disciplines into English have been eliminated.

The following changes were made to the undergraduate educational programs "6B07109 - Industrial Electronics and Control Systems" and "6B07113 - Intelligent Control Systems (Automation and Control)" in accordance with the comments of the accreditation commission:

- the discipline "Foreign language" is taught in the language that the student studied at school. As a result, this discipline was called "Foreign language", so that the student can choose the language of study.

- the undergraduate discipline "Information and Communication Technologies" is a compulsory discipline introduced by the Ministry of Education and Science of the Republic of Kazakhstan.

- the name of the practice "Professional (Pre-Diploma) Practice" has been changed to "Diploma Preparation".

The following changes were made to the educational program "6B07109 – Industrial Electronics and Control Systems" in accordance with the comments of the accreditation commission:

- the name of the discipline "Algorithmization and Programming" was changed to "Computer programming".

- the name of the discipline “Machine Learning and Artificial Intelligence” was changed to “Introduction to machine learning and neural networks”.

- the name of the discipline “Signal Coding and Processing” was changed to “Channel Coding”.

- the name of the discipline “Higher Mathematics” was changed to “Engineering Mathematics”.

- the name of the discipline "Conversion Techniques" has been changed to "Electrical Power Conversion".

- The module name “Electronic and Optoelectric Devices” has been changed to “Electronic and Optoelectric Components”.

The following changes were made to the educational program "6B07113 - Intelligent Control Systems (Automation and Control)" in accordance with the comments of the accreditation commission:

- the name of the discipline “Introduction to Blockchain Technologies” was changed to “Introduction to Blockchain”. Accordingly, changes were made to the content of the module.

- the name of the module “Electrical Engineering” has been changed to “Fundamentals of Electrical Engineering”.

- the discipline "Differential Equations" is merged into one module with the discipline "Optimization methods and numerical methods". Module name changed to "Advanced Mathematical Techniques for Engineering".

- the name of the discipline "Process Simulation Modeling" was changed to "Internet of Things and Product Lifecycle Management".

- the name of the module “Higher Mathematics” has been changed to “Fundamentals of Mathematics and Physics for Engineers”.

The following changes were made to the master's educational programs "7M07125 - Electronics and Control Systems" and "7M07128 - Intelligent Control Systems (Automation and Control)" in accordance with the comments of the accreditation commission:

- the name of the discipline "Teaching Internship" was changed to "Pedagogical Practice".

- the name of the discipline “Power Devices and Systems” was changed to “Power Electronic Devices and Systems”.

The following changes were made to the educational program “7M07128 – Intelligent Control Systems (Automation and Control)” in accordance with the comments of the accreditation commission:

- in the description of the discipline “Optimal Control of Automation Systems”, technical errors related to translation have been fixed. Corrections have been made to the module handbook.

- the name of the discipline “IoT Design Systems” was changed to “IoT System Design”.

Criterion 1.5 Workload and Credits

Comment. In the Bachelor’s degree program “Intelligent Control Systems” there is one module, M-11, that awards 27 ECTS and could easily be split up into two or even three modules. The experts assume that this would fit much more neatly with the usually smaller modules.

Response. Module M-11, which was 27 ECTS credits, is divided into two modules.

Criterion 4.1 Module descriptions

Comment. The module handbooks do have a convincing structure in general, however, the contents are lacking in several regards. For one, as was already listed above, many titles suffered from mistranslations. This is a great drawback to cohesiveness between module title and actual teaching matter. The mistranslations within the module handbooks also emerge in both the module objectives and in the contents. This is especially serious when it comes to jargon that needs a precise denomination. The module handbooks have to be re-translated lest they be, at times, incomprehensible. Furthermore, there are instances in which the module title does not fit the contents or learning outcomes altogether. During the audit the experts could elicit that there were some parts of a module erroneously pasted elsewhere. It must be ensured that all modules are correctly displayed in the handbooks.

In some of the modules there are pieces of information missing from the handbook. This concerns, e.g., the person responsible for the module, a reading list, or contents. The module handbook must be presented in full with all information readily available.

Response. Information missing in some items of the modular catalog has been supplemented.

Also, the pre-requisites and post-requisites in the description of disciplines in the module catalog were carefully checked, inconsistencies were eliminated.

The full version of the description of disciplines for each program will be presented on the website of KazNU. al-Farabi.

Changes have been made to the description of the expected learning outcomes in professional skills in order to more clearly reflect the goals and specifics of the undergraduate and graduate programs.

G Summary: Peer recommendations (31.05.2023)

Taking into account the additional information and the comments given by KazNU the peers summarize their analysis and **final assessment** for the award of the seals as follows:

Degree Programme	**ASIIN Seal**	**Maximum duration of accreditation**	**Subject-specific label**	**Maximum duration of accreditation**
Ba Intelligent Control Systems	With requirements for one year	30.09.2029	Wählen Sie ein Element aus.	
Ma Intelligent Control Systems	With requirements for one year	30.09.2029		
PhD Intelligent Control Systems	With requirements for one year	30.09.2029		
Ba Industrial Electronics and Control Systems	With requirements for one year	30.09.2028		
Ma Electronics and Control Systems	With requirements for one year	30.09.2028		
PhD Automation and the Internet of Things	With requirements for one year	30.09.2028		

Requirements

For all degree programmes

A 1. (ASIIN 1.1) The learning outcomes have to be defined much more sharply, especially in regards to the differences between the degrees of a Bachelor's and Master's programme.

A 2. (ASIIN 4.1) The module handbooks must be translated more concisely with respect to the correct and consistent terminology. The prerequisites and post-requisites need rework and each module has to feature all relevant information.

A 3. (ASIIN 4.3) The finalized handbooks must be published online in full, readily available for consultation by all interested parties.

Recommendations

For all degree programmes

E 1. (ASIIN 1.3) It is recommended to consider more flexibility within the programmes, i.e., a less rigid system with more electives.

E 2. (ASIIN 5) It is recommended that teachers discuss with their students the results of the questionnaires and the possible improvements, the feedback cycles need to be closed.

For the Bachelor's degree programme "Intelligent Control Systems"

E 3. (ASIIN 1.5) It is recommended that the module M-11 with 27 ECTS be split up into two or three modules to conform to the size of the other modules.

E 4. (ASIIN 1.3) It is recommended to split up the module M-5, which consists of two disjunctive subjects, into two modules for cohesion.

H Comment of the Technical Committees

Technical Committee 02 – Electrical Engineering/Information Technology (07.06.2023)

Assessment and analysis for the award of the ASIIN seal:

The committee members discuss the case and follow the assessment of the peers without any changes.

The Technical Committee 02 – Electrical Engineering/Information Technology recommends the award of the seals as follows:

Degree Programme	ASIIN Seal	Maximum duration of accreditation	Subject-specific label	Maximum duration of accreditation
Ba Intelligent Control Systems	With requirements for one year	30.09.2029	–	–
Ma Intelligent Control Systems	With requirements for one year	30.09.2029	–	–
PhD Intelligent Control Systems	With requirements for one year	30.09.2029	–	–
Ba Industrial Electronics and Control Systems	With requirements for one year	30.09.2028	–	–
Ma Electronics and Control Systems	With requirements for one year	30.09.2028	–	–

Degree Programme	ASIIN Seal	Maximum duration of accreditation	Subject-specific label	Maximum duration of accreditation
PhD Automation and the Internet of Things	With requirements for one year	30.09.2028	–	–

Requirements

A 1. (ASIIN 1.1) The learning outcomes have to be defined much more sharply, especially in regards to the differences between the degrees of a Bachelor's and Master's programme.

A 2. (ASIIN 4.1) The module handbooks must be translated more concisely with respect to the correct and consistent terminology. The prerequisites and post-requisites need rework and each module has to feature all relevant information.

A 3. (ASIIN 4.3) The finalized handbooks must be published online in full, readily available for consultation by all interested parties.

Recommendations

For all degree programmes

E 1. (ASIIN 1.3) It is recommended to consider more flexibility within the programmes, i.e., a less rigid system with more electives.

E 2. (ASIIN 5) It is recommended that teachers discuss with their students the results of the questionnaires and the possible improvements, the feedback cycles need to be closed.

For the Bachelor's degree programme "Intelligent Control Systems"

E 3. (ASIIN 1.5) It is recommended that the module M-11 with 27 ECTS be split up into two or three modules to conform to the size of the other modules.

E 4. (ASIIN 1.3) It is recommended to split up the module M-5, which consists of two disjunctive subjects, into two modules for cohesion.

Technical Committee 04 – Informatics/Computer Science (15.06.2023)

Assessment and analysis for the award of the ASIIN seal:

The committee members discuss the case and follow the assessment of the peers with minor changes to the wording. For one, they prefer the denomination of “EQF 6” and “EQF 7” over “Bachelor’s” or “Master’s degree” (A 1); Furthermore they suggest that the designation “teachers” in E 2 be changed to “lecturers” for the sake of clarity.

The Technical Committee 04 – Informatics/Computer Science recommends the award of the seals as follows:

Degree Programme	ASIIN Seal	Maximum duration of accreditation	Subject-specific label	Maximum duration of accreditation
Ba Intelligent Control Systems	With requirements for one year	30.09.2029	–	–
Ma Intelligent Control Systems	With requirements for one year	30.09.2029	–	–
PhD Intelligent Control Systems	With requirements for one year	30.09.2029	–	–
Ba Industrial Electronics and Control Systems	With requirements for one year	30.09.2028	–	–
Ma Electronics and Control Systems	With requirements for one year	30.09.2028	–	–
PhD Automation and the Internet of Things	With requirements for one year	30.09.2028	–	–

Requirements

A 1. (ASIIN 1.1) The learning outcomes have to be defined much more sharply, especially in regards to the differences between EQF 6 and EQF 7.

A 2. (ASIIN 4.1) The module handbooks must be translated more concisely with respect to the correct and consistent terminology. The prerequisites and post-requisites need rework and each module has to feature all relevant information.

A 3. (ASIIN 4.3) The finalized handbooks must be published online in full, readily available for consultation by all interested parties.

Recommendations

For all degree programmes

E 1. (ASIIN 1.3) It is recommended to consider more flexibility within the programmes, i.e., a less rigid system with more electives.

E 2. (ASIIN 5) It is recommended that lecturers discuss with their students the results of the questionnaires and the possible improvements, the feedback cycles need to be closed.

For the Bachelor's degree programme "Intelligent Control Systems"

E 3. (ASIIN 1.5) It is recommended that the module M-11 with 27 ECTS be split up into two or three modules to conform to the size of the other modules.

E 4. (ASIIN 1.3) It is recommended to split up the module M-5, which consists of two disjunctive subjects, into two modules for cohesion.

I Decision of the Accreditation Commission (23.06.2023)

Assessment and analysis for the award of the subject-specific ASIIN seal:

The Accreditation Commission shares the general evaluation of the Technical Committees, but decides to make changes to recommendation E 2. The recommendation, which is about the evaluation of the teaching staff by students, criticizes that the students fill out questionnaires about teaching staff evaluation without there being plans to discuss the findings. Since feedback about the questionnaires – a necessary step to complete the feedback loop – is not given, the Accreditation Commission decides to make the recommendation a requirement (A 4).

As for the editorial suggestions made by TC 04, the Accreditation Commission affirms that "teachers" is not the right choice of word in E 2 (or A 4, respectively). Contrary to the proposal of TC 04, i.e. "lecturers", the Accreditation Commission chose the designation "teaching staff" to avoid confusion with the rank of lecturer.

Finally the suggestion to mention EQF 6 and EQF 7 in A 1 was rejected.

The Accreditation Commission decides to award the following seals:

Degree Programme	**ASIIN Seal**	**Maximum duration of accreditation**	**Subject-specific label**	**Maximum duration of accreditation**
Ba Intelligent Control Systems	With requirements for one year	30.09.2029	–	–
Ma Intelligent Control Systems	With requirements for one year	30.09.2029	–	–
PhD Intelligent Control Systems	With requirements for one year	30.09.2029	–	–

Degree Programme	ASIIN Seal	Maximum duration of accreditation	Subject-specific label	Maximum duration of accreditation
Ba Industrial Electronics and Control Systems	With requirements for one year	30.09.2028	–	–
Ma Electronics and Control Systems	With requirements for one year	30.09.2028	–	–
PhD Automation and the Internet of Things	With requirements for one year	30.09.2028	–	–

Requirements

A 1. (ASIIN 1.1) The learning outcomes have to be defined much more sharply, especially in regards to the differences between the degrees of a Bachelor's and Master's programme.

A 2. (ASIIN 4.1) The module handbooks must be translated more concisely with respect to the correct and consistent terminology. The prerequisites and post-requisites need rework and each module has to feature all relevant information.

A 3. (ASIIN 4.3) The finalized handbooks must be published online in full, readily available for consultation by all interested parties.

A 4. (ASIIN 5) Teaching staff needs to discuss with their students the results of the questionnaires and what improvements might be possible, the feedback cycles need to be closed.

Recommendations

For all degree programmes

E 1. (ASIIN 1.3) It is recommended to consider more flexibility within the programmes, i.e., a less rigid system with more electives.

For the Bachelor's degree programme "Intelligent Control Systems"

E 2. (ASIIN 1.5) It is recommended that the module M-11 with 27 ECTS be split up into two or three modules to conform to the size of the other modules.

E 3. (ASIIN 1.3) It is recommended to split up the module M-5, which consists of two disjunctive subjects, into two modules for cohesion.

J Fulfilment of Requirements

Analysis of the experts and the Technical Committees (10.06.2024)

Requirements

For all degree programmes

A 5. (ASIIN 1.1) The learning outcomes have to be defined much more sharply, especially in regards to the differences between EQF 6 and EQF 7.

Initial Treatment	
Peers	fulfilled Justification: The learning outcomes are reworked according to Bloom's taxonomy. The difference between the Bachelor's and Master's degree learning outcomes are comprehensive.
TC 02	fulfilled
TC 04	fulfilled

A 6. (ASIIN 4.1) The module handbooks must be translated more concisely with respect to the correct and consistent terminology. The prerequisites and post-requisites need rework and each module has to feature all relevant information.

Initial Treatment	
Peers	fulfilled Justification: The handbooks have been reworked and are much more stringent and concise.
TC 02	fulfilled
TC 04	fulfilled

A 7. (ASIIN 4.3) The finalized handbooks must be published online in full, readily available for consultation by all interested parties.

Initial Treatment	
Peers	fulfilled Justification: The handbooks are available online.

TC 02	fulfilled
TC 04	fulfilled

A 8. (ASIIN 5) Teaching staff needs to discuss with their students the results of the questionnaires and what improvements might be possible, the feedback cycles need to be closed.

Initial Treatment	
Peers	fulfilled Justification: The university has introduced regular joint discussions between lecturers and students to discuss feedback.
TC 02	fulfilled
TC 04	fulfilled

Decision of the Accreditation Commission (28.06.2024)

Degree Programme	ASIIN seal	Subject-specific Label	Maximum duration of accreditation
Intelligent Control Systems, Bachelor of Engineering and Technology	All requirements fulfilled		30.09.2028
Intelligent Control Systems, Master of Engineering Science	All requirements fulfilled		30.09.2028
Intelligent Control Systems, Doctor of Philosophy	All requirements fulfilled		30.09.2028
Industrial Electronics and Control Systems, Bachelor of Engineering and Technology	All requirements fulfilled		30.09.2028
Electronics and Control Systems, Master of Engineering Science	All requirements fulfilled		30.09.2028

Degree Programme	ASIIN seal	Subject-specific Label	Maximum duration of accreditation
Automation and Internet of Things, Doctor of Philosophy	All requirements fulfilled		30.09.2028

Appendix: Programme Learning Outcomes and Curricula

According to the diploma supplement the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the Bachelor degree programme Intelligent Control Systems:

ON1. To analyze the features of social, political, cultural institutions in the context of their role in the modernization of Kazakhstan society, to describe the stages of formation of independent Kazakhstan statehood in the context of the global and Eurasian historical process.

ON2. Use the conceptual apparatus, methods and tools of higher mathematics, automatic control, electrical engineering, automatic control systems for analysis and synthesis of information data streams of measuring instruments of automation systems;

ON3. To manage, analyze and monitor IoT devices in accordance with the approved regulatory documents, metrological characteristics and operating modes of IoT devices.

ON4. Install, maintain and monitor network equipment using information exchange protocols, rules and methods for establishing network connections, basic network services and principles of network security.

ON5. Design, develop and test software, perform conceptual, logical and physical database design, develop applications on local and cloud servers.

ON6. Design software for IoT devices, programme a graphical user interface, application business logic and machine-to-machine interaction for IoT systems.

ON7. Develop a simulation model of the object (process) in question, develop and verify programme code, test and upgrade IoT applications and devices.

ON8. To analyze the subject and problem areas and on its basis to design and develop an intelligent system, apply smart technology to solve applied problems.

ON9. Explore the tasks of managing production and technological processes, apply artificial intelligence methods in solving problems and making decisions, testing, implementing and maintaining intelligent control systems.

ON10. Conduct big data analysis, design and develop software tools for storing, processing and analyzing big data, use the services of cloud platforms to support modern application architectures.

ON11. Develop innovative solutions to integrate new technologies with existing IoT systems and create new intelligent solutions.

ON12.Work in a team, tolerantly perceiving social, ethnic and cultural differences, critically evaluate their activities, the activities of the team.

The following **curriculum** is presented:

1	**M-1 Module of social and cultural development** **M-2 Instrumental module** **M-3Module Physical Training** 25 ECTS		**M-4 Higher Mathematics and Algorithms** 9 ECTS	34
2	**M-2 Instrumental module** **M-3 Module Physical Training** 12 ECTS	Elective compone nt **(1 of 6)** 5 ECTS	**M-4 Higher Mathematics and Algorithms** 9 ECTS	26
3	**M- 2 Instrumental module** **M-3 Module Physical Training** 7 ECTS	**M-5 Differential equations and Digital Electrical Engineering** **M-6 Intelligent Systems and Databases** **M-7 Optimization methods and numerical methods** 24 ECTS		31
4	**M-1 Module of social and cultural development** **M-3 Module Physical Training** 7 ECTS	**M-5 Differential equations and Digital Electrical Engineering** **M-6 Intelligent Systems and Databases** **M-7 Optimization methods and numerical methods** 22 ECTS		29
5	**M-8 Automatic regulation systems** 6 ECTS	**M- 10 Modeling IIoT control systems** **M-10 IoT automation environment** **M-10 Big Data**	**M-11 Computer systems, servers of automation systems and control** 18 ECTS	30

		Analysis 6 ECTS		
6	M-8 Automatic regulation systems 9 ECTS	**Modeling IIoT control systems \ automation environment M-10 Big Data Analysis** 12 ECTS	**M-11 Computer systems, servers of automation systems and control** 9 ECTS	30
7	**M-9 Interaction in automatio n systems** 6 ECTS	**M-12 Project management , visualization & practice** 6 ECTS	**M-13 Web Application Design and IIoT Prototyping M-13 Smart systems and technologies M-13 Blockchain Technologies and Cloud Computing** 24 ECTS	36
8	**M-9 Interact ion in automat ion systems** 9 ECTS	**M-12 Project manage ment, visualizat ion & practice** 3 ECTS	**FINAL ATTESTATION** 12 ECTS	24

According to the diploma supplement the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the Master degree programme Intelligent Control Systems:

ON1. Apply mathematical methods, models and algorithms in the construction of intelligent control systems, design and use decision support systems in automated systems according to the principles of Industry 4.0.

ON2. Apply network channel security methods, monitor the system to detect vulnerabilities (in the network, in applications, in devices), and ensure the security of IoT systems.

ON3. Conduct an analysis to predict the maintenance of IoT devices, design collective smart M2M device touch models and prototypes of virtual models.

ON4. Develop models of IoT systems according to customer requirements, expand the functionality of IoT systems and improve the performance of individual tasks in accordance with a new or supplemented technical task.

ON5. To develop hardware and software for IoT systems to stimulate innovation in the field of digitalization of the industry, to design and use inter-machine communication software for smart systems.

ON6. Apply software for processing, storage and transmission of cloud data, conduct research in the field of analysis and design of embedded IoT systems using cloud services.

ON7. Develop methods for processing and analyzing big data of corporate systems and applications to improve business processes; Create software tools for storing big data and extracting useful information from them.

ON8. Conduct scientific and pedagogical activity, introduce research results into practical pedagogical activity, lead a research group.

ON9. Independently conduct research, understand current research issues, analyze and critically relate to various sources of information, use them to structure and formulate reasoning.

ON10. Use methods and tools from various multidisciplinary fields, present research results in various forms in national scientific publications, at conferences tailored to the specifics of the audience, be tolerant.

The following **curriculum** is presented:

1	**M-1 Module on history and philosophy of science M-2 Psychology and Pedagogy Module** 6 ECTS	**M-3 Intelligent Control Systems and «Industry 4.0» solutions M-3 IoT systems** 6 ECTS	**M-4 Mathematical methods and objects control** 12 ECTS	**RES.** 3 ECTS	27
2	**M-1 Module on history and philosophy of science M-2 Psychology and Pedagogy** 14 ECTS	**M-3 Intelligent Control Systems and «Industry 4.0» solutions** 9 ECTS	**M-4 Mathematical methods and objects control** 6 ECTS	**RES.** 4 ECTS	33
3	**M-5 Inter-machine interaction and IoT design systems** 13 ECTS	**M – 6 Intelligent control systems and robots M-6 IoT and automated systems** 18 ECTS		RES. 2 ECTS	33
4	**RESEARCH** 15 ECTS	**FINAL ATTESTATION** 12 ECTS			27

According to the diploma supplement the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the doctorate degree programme Intelligent Control Systems:

ON1. State the concepts of system analysis, the basic principles of the synthesis of automatic control systems, create mathematical models in the field of automation of production based on the algorithms of system analysis and process control.

ON2. To design control systems for complex production and scientific processes using the theory of extreme problems, the basic principles of building automatic control systems. To design control systems for complex production and scientific processes using the theory of extreme tasks, the basic principles for constructing automatic control and control systems, methods and criteria for stability analysis.

ON3. Create simulation models of the work of modern educational and industrial controllers, multiprocessor industrial complexes for industrial automation and intellectualization of process control according to the principles of Industry 4.0.

ON4. Design and develop prototypes of IoT devices based on modern microcontrollers, built-in data exchange systems using M2M technology, offer new hypotheses and solutions to scientific problems in the field of intelligent control systems based on an independent original approach.

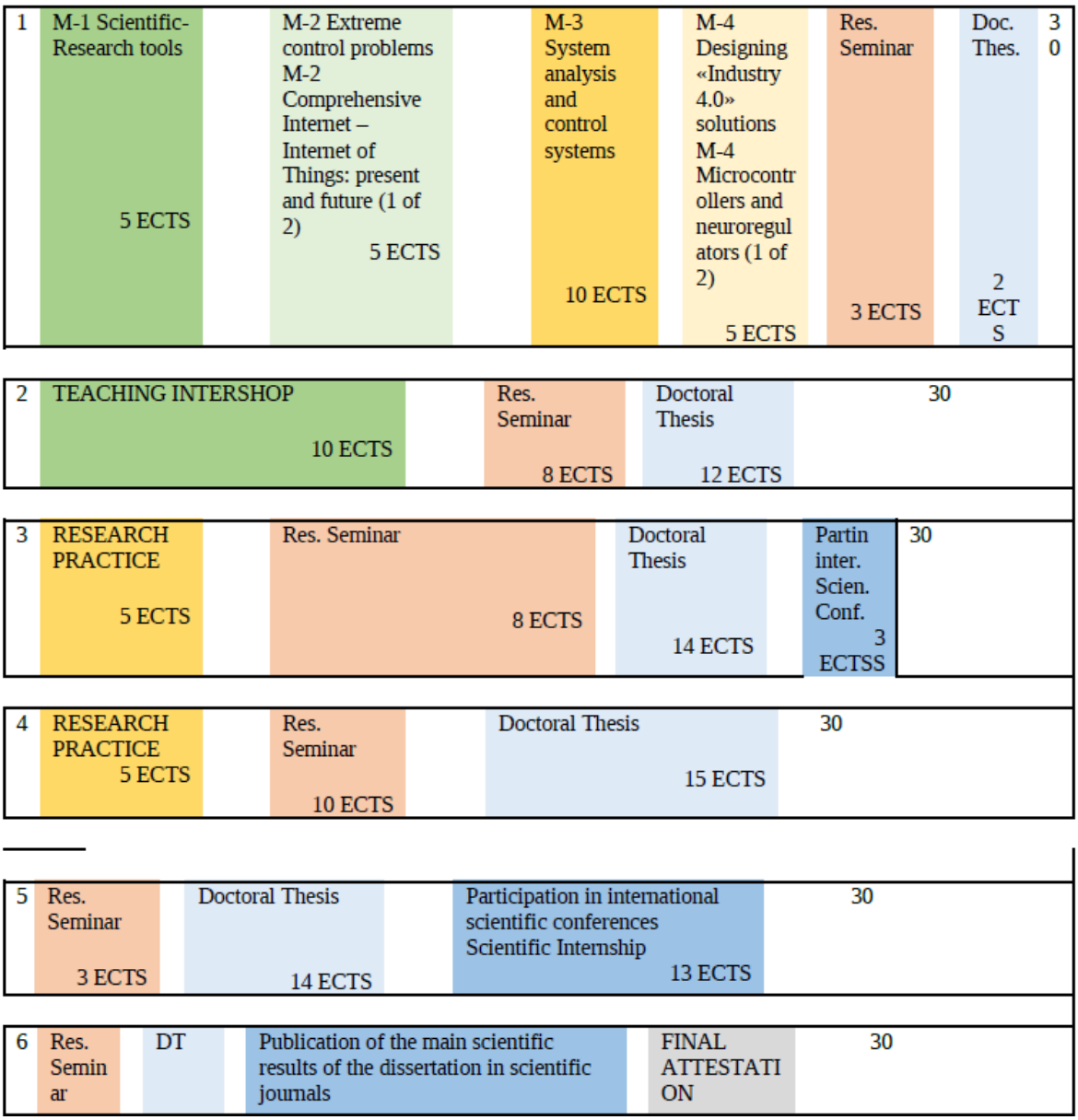
ON5.Use methods and tools from various multidisciplinary fields, determine the quality parameters of the technological process, intended for intellectualization, evaluate the prospects of using neuroregulators in process control.

ON6.Conduct teaching activities in higher education institutions, introduce advanced and innovative teaching technologies, develop educational and methodological support for new courses, taking into account the social modernization of Kazakhstan and the development of the national economy.

ON7. Apply modern methodology, tools and standards in the field of project management, apply research methods, contribute to original research, draw up research programs, obtain the necessary data from scientific and technical documents, reports and other reference materials.

ON8. Build the research process on the topic of the dissertation, use the academic style of writing, present and discuss research results at conferences, in scientific discussions and publications in national and international peer-reviewed publications, contribute to the development of society, work in a team, support the training of others using research and education, and through other professional skills.

The following **curriculum** is presented:



According to the diploma supplement the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the Bachelor degree programme Industrial Electronics and Control Systems:

LO1. Understand the basic physical processes underlying electronics, optoelectronics, microelectronics and electrical engineering, apply mathematical methods of calculation, analysis and modeling of electrical circuits in order to design digital and analog electronic measuring devices and devices for various special purposes.

LO2. Explain the physical and mathematical principles and methods of designing electrical circuits underlying digital processing and encoding of information, data mining, building de-

cision-making algorithms, the basics of control theory, modern methods of designing artificial intelligence for image processing, computer vision, neural networks and machine learning, as well as the design of robotic systems.

LO3. Apply physical and mathematical methods for transmitting, receiving and processing signals in control systems, communication equipment and control and monitoring units, and interpret the results obtained using digital electronic devices in control systems.

LO4. Solve engineering problems in the field of analog and digital electronics, adaptive control systems and robotic systems using modern hardware and software, for the design of electronic devices for various purposes;

LO5. Use modern methods of modeling, programming and simulation to develop functional blocks of industrial electronic devices based on modern microprocessors, microcontrollers, programmable logic integrated circuits and electronic sensors.

LO6. Design electronic devices and digital control units using electrical and optical components, integrated circuits, microprocessors and microcontrollers for the development of digital devices used in industrial electronics using modern hardware and software.

LO7. Integrate and analyze the basic principles of building industrial, converter electronic systems at the hardware level for diagnostics and testing using appropriate software.

LO8. Apply design methods of analog and digital electronic devices, coding, filtering, transmission, reception and protection against failures and unauthorized access to develop industrial intelligent adaptive control systems.

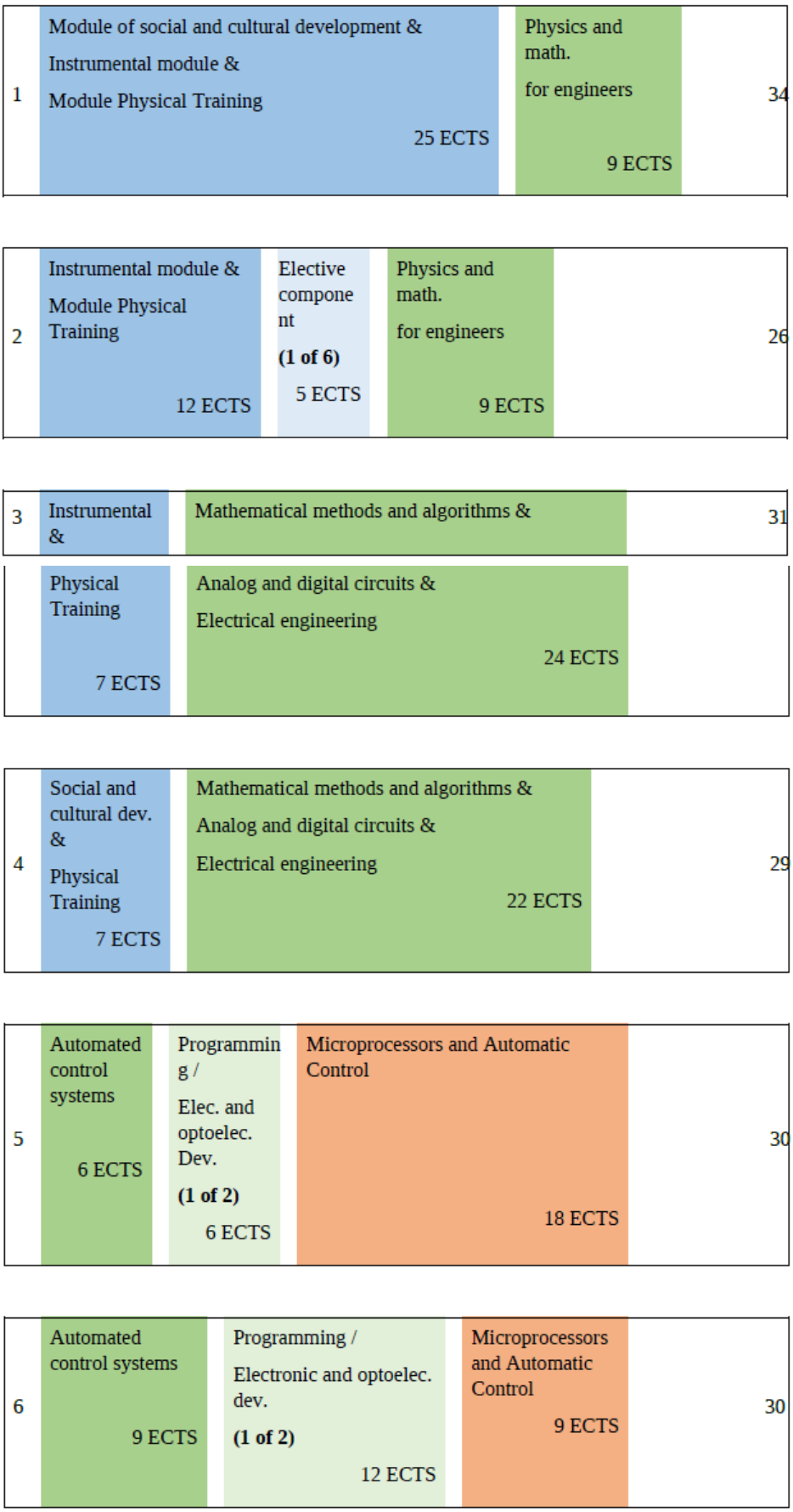
LO9. To organize industrial process control systems using automated process control systems for the design of monitoring systems, remote control and IoT technologies.

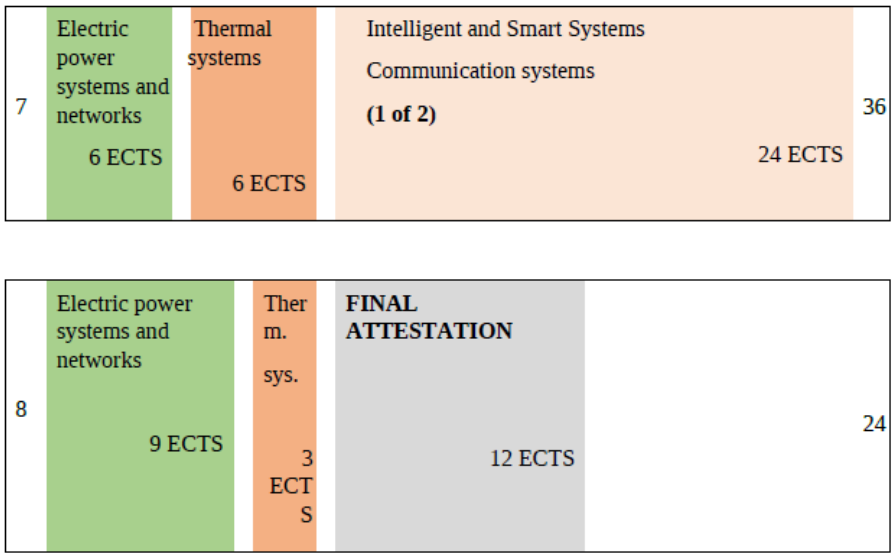
LO10. Design and perform calculations of individual blocks and electronic devices, control and automation systems, computing and measuring equipment and robotic systems to solve the technical problem.

LO11. Design digital electronic systems using modern SMART technologies and the Internet of Things to meet the desired needs within real constraints, such as economic, environmental, social, ethical, health and safety, manufacturability and sustainable development.

LO12. Apply the fundamental principles, methodologies and concepts of the culture of interpersonal communication, including in a foreign language, have systematic thinking when setting goals and objectives related to professional activity, form your own point of view in ideological and civil issues, commercialize the results of professional activity, ensure the protection of intellectual property in the development of electronic and digital devices;

The following **curriculum** is presented:


1
Module of social and cultural development &
Instrumental module &
Module Physical Training
25 ECTS
Physics and math.
for engineers
9 ECTS
34
2
Instrumental module &
Module Physical Training
12 ECTS
Elective component
(1 of 6)
5 ECTS
Physics and math.
for engineers
9 ECTS
26
3
Instrumental &
Mathematical methods and algorithms &
31
Physical Training
7 ECTS
Analog and digital circuits &
Electrical engineering
24 ECTS
4
Social and cultural dev. &
Physical Training
7 ECTS
Mathematical methods and algorithms &
Analog and digital circuits &
Electrical engineering
22 ECTS
29
5
Automated control systems
6 ECTS
Programming /
Elec. and optoelec. Dev.
(1 of 2)
6 ECTS
Microprocessors and Automatic Control
18 ECTS
30
6
Automated control systems
9 ECTS
Programming /
Electronic and optoelec. dev.
(1 of 2)
12 ECTS
Microprocessors and Automatic Control
9 ECTS
30



According to the diploma supplement the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the Master degree programme Electronics and Control Systems:

LO1. Explain the principles of construction of devices of automated control systems, in order to determine their function and characteristics of structural units of power, digital devices and electronic sensors;

LO2. Apply methods of designing nonlinear adaptive systems and neural networks to create intelligent control systems using deep machine learning mechanisms;

LO3. Design embedded systems using modern digital integrated circuits for use in control units of intelligent and multi-agent systems.

LO4. Use modern digital data transmission systems to create wired and wireless communication channels using Internet of Things technology and sensor networks in automated control systems;

LO5. To develop power and electronic functional blocks of control systems of embedded systems, to characterize their structural modules, to ensure uninterrupted communication between them for remote control and monitoring in real time using Internet of Things technology;

LO6. Analyze the applicability of intelligent systems using neural networks and machine learning methods for data processing in order to improve the efficiency of the technological process;

LO7. Solve problems related to the creation of automated dispatch control and monitoring of data from the sensor system using modern technologies of various data transmission technologies, using the Internet of Things;

LO8. To determine the key features and functional characteristics of the adaptive automated control systems being developed based on neural networks in order to optimize the technological process;

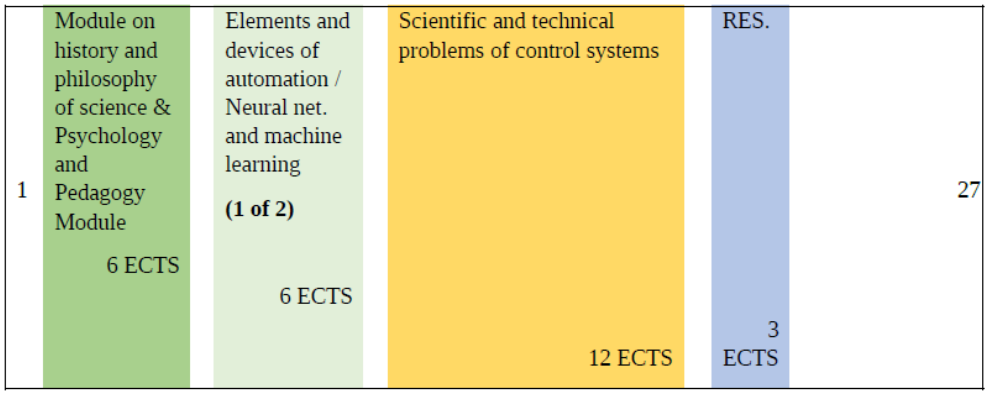
LO9. To demonstrate a high level of competence in the development of project documentation, educational and methodological complexes, to determine the goals and methods of solving analytical and technical problems in the field of automated control systems;

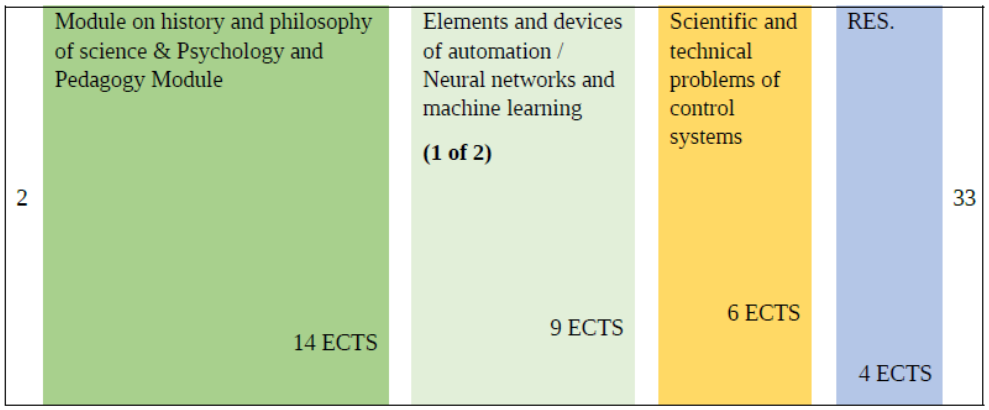
LO10. Integrate the skills and abilities of designing and developing electronic and power devices to create hardware and software for intelligent control systems;

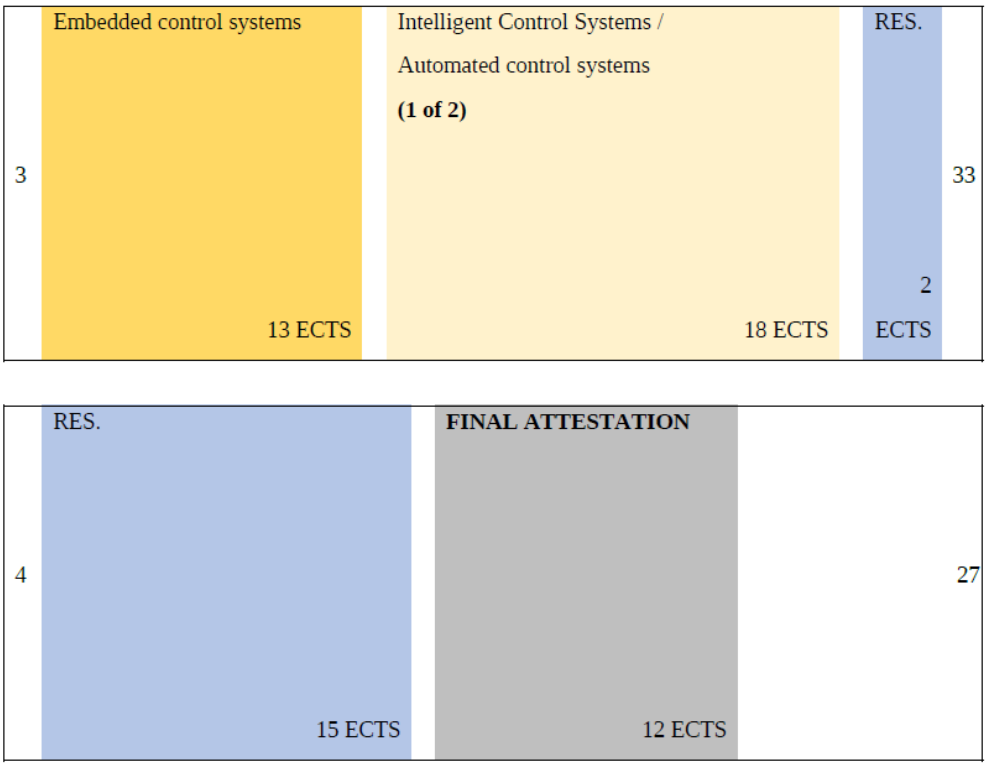
LO11. Evaluate adaptive and nonlinear methods used in embedded control systems, identify advantages and disadvantages in the operation of these systems in order to improve the existing system;

LO12. Demonstrate a civic and ideological position, formulate problems, goals, tasks in the theoretical and practical spheres of management systems, work with foreign scientific and technical literature, participate in international cooperation in the field of professional activity, be able to organize the work of scientific and technical personnel, use an individual approach to students in the implementation of pedagogical activities in the field of electronics and control systems.

The following **curriculum** is presented:







According to the diploma supplement the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the doctorate degree programme Automation and Internet of Things:

ON1. Demonstrate an interdisciplinary understanding of the concepts of modern automatic regulation and control systems, the role of the Industrial Internet of Things in improving the productivity of technological processes.

ON2. Analyze, evaluate and select elements, methods and standards of modern control systems, architecture of microcontroller devices, software tools for the purpose of their further application in the development of large-scale engineering control systems.

ON3. Apply microcontroller technology in manufacturing industries, design and develop IoT applications and services adapted to the industrial needs of "Industry 4.0".

ON4. Build mathematical models of optimal control, analyze the controllability and observability of systems, design fuzzy control systems and control systems based on artificial neural networks.

ON5. Design and prototype IoT devices based on microcontrollers and PID controllers using intelligent control methods.

ON6. Critically evaluate and predict the ways of development of automation and control of complex technical and socio-economic control objects in the form of formalized mathematical and computer control models.

ON7. Propose new hypotheses and solutions to scientific problems in the field of design and development of intelligent automated control systems based on an independent original approach; contribute to the development of society.

ON8. Build a research process on the topic of the dissertation, present and discuss the results of research in oral and written form at national and international scientific conferences, in scientific discussions and publications in national and international peer-reviewed publications.

The following **curriculum** is presented: