Institute of Automation and Information Technology
Department of Electronics, Telecommunications and Space Technologies

EDUCATIONAL PROGRAM
7M06201 Telecommunications

Code and classification of the field of education: 7M06 Information and communication technologies
Direction of training: 7M062 Telecommunications
Group of educational programs: M096 Communications and communication technologies
NRC level: 7
ORK level: 7
Duration of study: 2 years
Amount of credits: 120

Almaty 2025

Educational program 7M06201 "Telecommunications" was approved at a meeting of the Academic Council of KazNITU named after K.I. Satpayev.

Protocol No. 10 from "06" 03 2025

Reviewed and recommended for approval at a meeting of the Educational and Methodological Council of KazNITU named after K.I. Satpayev.
Protocol No. 4 dated "20" _12_ 2024

The educational program "7M06201 Telecommunications" was developed by the academic committee in the direction of M096 - Communications and communication technologies."

Full Name	Academic degree / academic title	Position	Place of work	Signature
Chairman of the Academic Committee				
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Employers				
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Students				
S. Kegenbayeva	–	2nd year Doctoral student	NJSC Kazakh National Research Technical University named after K.I. Satpayev	

Content

List of abbreviations and designations

OP – Educational program
ERS – Remote Sensing of the Earth
TCS – Telecommunication systems
RTS – Radiotechnical Systems
EIRP – Equivalent Isotropic Radiated Power
KS - Space stations
FM – frequency modulation
EIRP – equivalent isotropic radiated power
KS - Space stations
FM – Frequency Modulation
FPGA – Programmable Logic Integrated Circuits
CAD – Computer-aided design
WSN – Wireless Sensor Network
RF – Radio Frequency
xWDM – Wavelength Division Multiplexing
ECAD – Electronic Computer-Aided Design
PMI PMBOK – Project Management Institute – Project Management Body of Knowledge
IPMA ICB – International Project Management Association – Individual Competence Baseline
PCM – Pulse Code Modulation
FOCL – Fiber-optic communication line
FPGA – Field-Programmable Gate Array
DSP – Digital Signal Processor

1. Description of the educational program

The educational program (hereinafter referred to as the EP) is a set of documents developed by the Kazakh National Research Technical University named after K.I. Satpayev and approved by the Ministry of Education and Science of the Republic of Kazakhstan.

For this purpose, the student undergoes a course of theoretical training and carries out scientific research that has significant relevance and practical significance. The results of the research are presented in the form of a master's thesis, the defense of which occurs in the established manner. In case of successful completion of the full course of study of the master's degree, the graduate is awarded the academic degree of "Master of Engineering Sciences" in the field of engineering telecommunications and intelligent infocommunications.

The program is aimed at training specialists who ensure innovative development and modernization of promising telecommunication applications. The content of the EP disciplines was developed taking into account modern trends in the development of telecommunications and master's educational programs of leading foreign universities in the world. Master's students study the current state of radio engineering, electronics and telecommunications, digital signal processing in telecommunications, microcontrollers, wireless broadband and sensor networks. A special feature of the program is a large number of experimental studies.

Master's students undergo professional, scientific research and scientific-pedagogical practice in the leading universities of the world, actively participate in scientific research and experimental research work, and can study abroad for a semester under academic mobility programs. Professors from leading universities of the world are invited to give lectures and trainings.

Graduates work in well-known mobile and space communications companies, radio and television centers, in the field of development, implementation and operation of the following systems: telecommunications, radio communications, television, radio broadcasting, radar and navigation, radio control, mobile communications.

2. The purpose and objectives of the educational program

The purpose of the OP: Training of highly qualified specialists based on the integration of education and science, an effective system for training scientific, scientific and pedagogical personnel of a new formation, capable of solving issues of improving society, science and developing new technologies in engineering telecommunications and in intelligent information and communication systems.

Responsibilities of the OP:

Mastering a cycle of general education disciplines to ensure social and humanitarian education based on the laws of social and economic development of society, history, state and foreign languages, as well as modern information

technologies.

• Study of a cycle of basic disciplines to form the basis of professional training in the field of natural, general technical and economic sciences.

• Development of skills in conducting scientific research in the field of electronics, optoelectronics and nanophotonics, as well as mastering the development of intelligent systems and their application in electronic engineering.

• Acquisition of theoretical knowledge and development of practical skills in microprocessor complexes designed to control processes in engineering automated control systems and information and communication systems.

• Providing students with knowledge of modern engineering technologies, intelligent microprocessor systems, design of analog and digital circuits, their key aspects and applications.

• Development of competencies necessary for work in research and innovation centers, in high-tech industries, as well as in the field of scientific and pedagogical activities.

• Development of abilities to assess, analyze and solve production problems, monitor and manage technological processes.

• The disciplines “Theory and practice of solar-based photogenerators”, “Intelligent and specialized automated control systems in the electric power industry”, “Power electronics and intelligent energy systems” correspond to all stages of achieving SDG 7 – Ensuring universal access to affordable, reliable, sustainable and modern energy sources.

The educational program is aimed at training Master's degree students in the field of "Master of Engineering Sciences" working at enterprises, complexes, institutions, educational organizations and other facilities using engineering and technological systems. They can work professionally in the field of electronic and electrical engineering, microprocessor complexes for automatic control, digital technologies, various types of sensors, information and communication systems, as well as processing and converting information using electronic devices. In addition, future specialists will be able to contribute to the development of stable and efficient energy sources, develop skills in the design and implementation of intelligent control systems. By increasing energy efficiency, they help reduce the carbon footprint and develop environmentally friendly technologies. Thanks to this knowledge and skills, graduates play an important role in increasing the reliability of energy systems and ensuring affordable energy for all in accordance with SDGs 7.1, 7.2, 7.3.

3Requirements for the assessment of learning outcomes of the educational program

OP 7M06201 – “Telecommunications” ensures that all students achieve the learning outcomes necessary for professional activity. Upon completion of the program, students must:

– study of a cycle of general educational disciplines to ensure social and humanitarian education based on the laws of social and economic development of society, history, state language, Russian and foreign languages, modern information

technologies;

– study of a cycle of basic disciplines to obtain natural science, general technical and economic knowledge as the foundation of professional education;

– study of a cycle of specialized disciplines for the formation of theoretical knowledge, practical skills and abilities in use for managing processes in engineering telecommunications systems, as well as in information and communication systems;

– acquisition of skills and abilities in performing technical calculations and substantiating design decisions using modern computer technologies and intelligent programs;

– study of disciplines that develop knowledge, skills and abilities in planning and organizing theoretical and laboratory research;

– familiarization with technical processes, systems of organization, planning and production management during various types of practice.

Graduates who successfully complete the training under this program are awarded the academic degree of "Master of Engineering Sciences" in the field of "Telecommunications". The types of work activities of graduates of the educational program are enterprises, complexes, institutions, educational organizations and other facilities where technological systems, technical means are used that ensure any transmission, radiation and reception of signs, signals, written text, images, sounds - by wire, radio, optical communication, as well as the transformation of information by electronic means or infocommunication communication systems.

The objects of professional activity of the educational program are the field of science and technology, which includes a set of technologies, means, methods and techniques of human activity aimed at creating conditions for the exchange of information at a distance and the transformation of information using electronic and radio engineering means.

4. Passport of the educational program

4.1. General information

No.	Field name	Note
1	Code and classification of the educational field	7M06 Information and Communication Technologies
2	Code and classification of training areas	7M061 Telecommunications
3	Group of educational programs	M096 Communications and Communication Technologies
4	Name of the educational program	Telecommunications
5	Brief description of the educational program description	Upon successful completion of the full course of study of the Master's degree, the graduate is awarded the academic degree of "Master of Engineering Sciences" in the field of engineering telecommunications and intelligent infocommunications. The educational program is aimed at training highly qualified specialists with deep theoretical knowledge and practical skills in the field of telecommunications technologies, capable of ensuring innovative development, implementation and modernization of promising solutions in the telecommunications industry.

		The content of the educational program disciplines was developed taking into account modern global trends in the development of telecommunications, digital technologies, as well as based on the best practices of master's educational programs of the world's leading technical universities. The program includes both fundamental disciplines that provide a solid scientific basis, and applied modules aimed at developing competencies in the field of design, analysis and optimization of telecommunication systems. During their studies, master's students study the current state and development prospects of radio engineering, electronics and telecommunication systems, including digital signal processing in the infocommunication environment, microcontroller architecture, wireless broadband data transmission technologies, as well as the principles of construction and operation of sensor networks. A special feature of the educational program is its significant research and experimental component, aimed at developing students' skills in conducting independent research, analyzing engineering and technical problems, and developing innovative solutions. The program involves active participation of master's students in research projects, including those involving international partner universities and organizations, scientific and industrial internships, and academic mobility. This provides graduates with a high level of competitiveness in the global labor market in the field of telecommunications and information and communication technologies.
6	Purpose of the OP	The goal of the educational program 7M06201 - "Telecommunications" is to train highly qualified and competitive specialists in the field of engineering telecommunications and intelligent information and communication systems, possessing deep theoretical knowledge and practical skills in the field of design, analysis and modernization of modern telecommunication technologies. The program is aimed at developing professional competencies in master's students necessary for conducting scientific research, implementing innovative developments, and effectively managing processes in engineering and infocommunication systems. Training is carried out on the basis of integrating education, science and practice, taking into account modern global trends, digitalization and sustainable development.
7	Type of OP	educational program
8	Level according to NRC	7
9	Level according to ORK	7
10	Distinctive features of the OP	has no specific features
11	List of competencies of the educational program:	The duration of study in the Master's program is determined by the volume of academic credits earned. Upon full acquisition of the established volume of academic credits and achievement of the expected learning outcomes provided for by the educational program, the Master's program is considered completed. For the

		educational program of the scientific and pedagogical direction "Telecommunications", the duration of study is 2 years, which corresponds to 120 academic credits. Planning of the content of education, as well as methods of organizing and conducting the educational process, is carried out by higher education institutions and scientific organizations independently, on the basis of credit technology of education, taking into account international academic requirements and standards. The Master's degree program implements educational programs aimed at training scientific, teaching and management personnel with in-depth professional training in the field of telecommunications and infocommunication technologies. The content of the Master's degree program includes: – theoretical training, covering the study of cycles of general education, basic and specialized disciplines; – practical training, including various types of professional, scientific and pedagogical practice, as well as internships; – experimental research work, including the completion and defense of a master's thesis; – final certification confirming the student's achievement of all stated learning outcomes. The educational program "Telecommunications" is implemented in accordance with the principles of credit technology of education and is carried out in the state and Russian languages, ensuring flexibility, academic mobility and compliance with international standards for training masters in the field of telecommunications and intelligent information and communication systems.
12	Results of the implementation of the educational program:	PO1 – Demonstrate the ability to use English, Kazakh (Russian) languages as a means of business and professional communication, a source of new knowledge in the field of engineering telecommunications or infocommunications; know and apply in work and life the basics of applied ethics and business communication ethics. PO2 – Demonstrate the possibilities of creating, developing and designing new telecommunication systems (synthesis) with elements of smart technology and intelligent systems. Modeling and optimization of network protocols. PO3 Assess the commercial principles of business activities, meeting public needs for the services of telecommunications enterprises with the humanitarian objectives of personnel development and social values of Kazakhstani society. PO4 – Illustrate the analysis, search and acquisition of new information necessary to solve professional problems in the field of knowledge integration as applied to telecommunications. Participate in the analysis and analysis of critical situations of enterprises, organizations in the telecommunications industry. PO5 – Operate complex knowledge in the studied field of engineering electronics, telecommunications and Internet of Things technology, as well as modeling methods and optimal

		telecommunication systems. PO6 – Demonstrate readiness for self-study and continuous professional development throughout the entire period of scientific or professional activity, the ability to make independent scientific technical decisions in the field of engineering telecommunications and intelligent infocommunications. PO7 – Demonstrate understanding and presentation of the main ideas in the organization of procedural issues of engineering telecommunications, understanding the principles of operation of electronic circuits and communication protocols and the organization of information and communication links between consumers. PO8 – Use the acquired knowledge on digital communication technology, the Internet of Things, heterogeneous networks, multi-channel information transmission, noise immunity and telecommunications organization processes.
13	Form of study	Eyes
14	Duration of study	2 year
15	Volume of loans	120 credit
16	Languages of instruction	Kazakh, Russian, English
17	Academic degrees awarded	Master of Engineering Sciences
18	Developer and authors:	E. Tashtai, Khabay A

4.2 The relationship between the attainability of the learning outcomes formed under the educational program and academic disciplines

			Number of credits	Formed learning outcomes (codes)						
				RO1	PO2	PO3	PO4	RO5	RO6	RO7
	Cycle of general education disciplines, Required component									
1	Foreign language (professional)	The course is designed for master's degree students in technical specialties to improve and develop their communication skills in a foreign language in the professional and academic sphere. The course introduces master's degree students to the general principles of professional and academic intercultural oral and personal communication using modern pedagogical technologies (round table, discussions, debates, analysis of professionally oriented situations, project). The course ends with a final exam. Master's degree students must also study independently.	**2**	V						
2	Pedagogy of Higher Education	The purpose and objectives of the course - the course is aimed at studying the psychological and pedagogical essence of the educational process of the university; forming ideas about the main trends in the development of the university at the present stage, examining the methodological foundations of the educational process of the university, as well as psychological mechanisms that affect the success of learning, interaction, management of subjects of the educational process. Development of psychological and pedagogical thinking of master's students. Brief description of the course: during the course, master's students become familiar with the didactics of the	**2**	V						

		university, forms and methods of organizing university education, psychological factors of successful education, features of psychological influence, mechanisms of educational influence, pedagogical technologies, characteristics of pedagogical communication, mechanisms of managing the learning process. Analyzes organizational conflicts and ways of resolving them, violations and deformations of the psychologically normal structure of the teacher's personality.								
3	Psychology of Management	The course is aimed at mastering the tools of effective personnel management, based on knowledge of the psychological mechanisms of managerial activity. The lesson will help master the skills of decision-making, creating a favorable psychological climate, motivating employees, setting goals, building a team and communicating with employees. Upon completion of the course, master's students learn to resolve management conflicts, create their own image, analyze situations in the field of management activity, as well as negotiate, be stress-resistant and effective leaders.	**2**	V		**V**				
4	History and scientific philosophy	The purpose and objectives of the course are to reveal the relationship between philosophy and science, to identify the philosophical problems of science and scientific knowledge, the main stages of the history of science, the leading concepts of the philosophy of science, and modern problems of the development of scientific and technical reality. Brief description of the course - the subject of philosophy of science, the dynamics of science, the specifics of science, Science and prevention, antiquity and the formation of theoretical science, the main stages of the historical development of science, the features of classical science, non-classical and post-classical science, mathematics,	**3**	V						

		physics, philosophy of technology and technology, the specifics of engineering science, scientific ethics, study and social and moral responsibility of an engineer.								
Cycle of basic disciplines Component of choice										
5	Software Defined Radio Basics	This course contains training materials on the fundamentals of communication systems and digital signal processing for creating a software communication system, which are taught to graduates (including undergraduate and doctoral students) in the fields of electrical engineering, radio engineering, electronics and telecommunications, and computer science. After studying these materials, students implement various communication systems and investigate communication signals in the real world.	**5**				V			V
6	Project management	Objective: Study of project management principles using modern business management technologies Contents: The course studies the components of project management based on modern behavioral models of project-oriented business development management. The program is based on international standards PMI PMBOK, IPMA ICB and RK standards in the field of project management. The features of organizational management of business development are studied through the interaction of strategic, project and operational management	**5**		V			V		
7	Intellectual Property and Scientific Research	The aim of this course is to provide master's degree students with the knowledge and skills necessary to understand, protect and manage intellectual property (IP) in the context of scientific research and innovation. The course aims to prepare specialists who are able to effectively work with IP, protect the results of scientific research and apply them in practice.	**5**		V		V			
8	Intelligent micro and nano sensor devices	The purpose of studying the discipline is to deepen knowledge about the physical and technological	**5**					V	V	

		foundations of building micro and nanosensory devices. When mastering the discipline "Micro and nanosensory devices", basic knowledge is formed on the fundamental physical foundations of the principles of operation of micro and nanosensory devices, and general ideas will be obtained about possible ways of further development of micro and nanosensory devices								
9	Modern sensor communication networks	Modern sensor communication networks, their structure, technological aspects of construction, services provided, issues of ensuring quality of service. Sensors united in a wireless network form a territorially distributed self-organizing system of collection, processing and transmission of information. Construction of a distributed, self-organizing and multiple sensors and actuators, united by a radio channel. Methods of load forecasting, calculation of service indicators, calculation of data traffic characteristics.				V			V	
10	Design of electronic devices	The purpose of studying the discipline is to familiarize undergraduates with the basic principles, methods and concepts of designing radio-electronic devices (RED), to introduce them to the basic technological processes of creating RED. Modeling analog systems at the functional level with different speeds and frequencies, taking into account real radio frequency effects; designing algorithms for digital processing and signal conversion; support for models based on X-parameters for joint modeling of analog and digital parts of the device; hundreds of replenished libraries with blocks of various modern standards								
11	Digital Signal Processing Technology	Basic concepts of physical quantities, measurement and signal transformation. Classification of signals:								

		deterministic and random signals, continuous, discrete and quantized signals. Types of deterministic signals, their parameters. Single pulse, constant signal, harmonic and polyharmonic signals. Decomposition of a periodic signal into a Fourier series. Signal spectrum. Non-periodic (transient) signals. Fourier transform for transient signals. Analog systems. Pulse and transient characteristics. Transfer coefficient.								
12	Digital signal processing in telecommunications	The basis for preliminary signal processing are the procedures of fast discrete orthogonal transformations, which are implemented in various functional bases, procedures of linear and nonlinear filtering, linear algebra. The principle of combining and separating channels of a group signal, the formation of linear sums of channel signals, methods of linear separation by frequency, time and by signal shape, their use for constructing multichannel systems, transmission of a group signal of many subscribers by one transmitter								
13	Sustainable Development Strategies	Objective: To teach Master's students sustainable development strategies to achieve a balance between economic growth, social responsibility and environmental protection. Content: Master's students will study the concepts and principles of sustainable development, the development and implementation of sustainable development strategies, the assessment of their effectiveness, as well as international standards and best practices. Includes cases and examples of successful sustainable development strategies.								
Cycle of major disciplines University component										
14	Fundamentals of optical and radar systems for remote sensing of the Earth	When studying this discipline, master's students master complex approaches to processing Earth remote sensing (ERS) data, where they analyze the obtained measurement	**5**			V			V	

		results using various tools and technologies, including sensors that take pictures in the optical and radar ranges, and become familiar with their work. Mastering the methods and algorithms for capturing optical and radar space images, allowing data to be processed automatically.								
15	Broadband wireless networks	The purpose of studying the discipline is to study the basics of building and using broadband wireless networks (BWN) and their elements based on pseudo-random sequences (PRS) in modern telecommunication systems. Applications of BWN in infocommunication systems of various architectures. Methods and tools for designing BWN. Modern wireless network technologies, principles of operation of sensor networks, use of modern protocols for network routing and data transmission.	**5**		**v**				V	
Cycle of major disciplines Component of choice										
16	Microcontroller programming	The objective of the course is the technology of designing microelectronic systems based on microcontrollers and LSI (large-scale integrated circuits). Programming and debugging tools for microprocessor controllers. Practical circuits and program circuits for programming microcontrollers and FPGAs. When designing microcontrollers, it is necessary to maintain a compromise between size and cost on the one hand and flexibility and performance on the other. For different applications, the optimal ratio of these and other parameters can differ greatly.	**5**			V	V			
17	Computer-aided design system in electronic devices	Stages of designing radio-electronic devices (RED). Selection and justification of the element base and materials for RED structures. Principles of designing RED. Layout tasks. Fundamentals of design automation. Fundamentals of ECAD architecture. Mathematical models (computer-aided design system) CAD. Parametric automation tasks.	**5**					V	V	

		Fundamentals of CALS technologies.								
18	Multichannel radio engineering information transmission systems	The objective of studying the discipline is to obtain the necessary knowledge on the physical and theoretical foundations of the functioning of multichannel radio engineering systems for transmitting information, processing signals and the principles of constructing advanced information processing systems. Analysis of spatial signal coding methods allows increasing the bandwidth of a channel in which data transmission and reception are carried out by systems of several antennas. The principle of combining and separating channels of a group signal, forming linear sums of channel signals, methods of linear separation by frequency, time and by signal shape, using them to construct multichannel systems, transmitting a group signal of many subscribers by one transmitter.	**5**							**v**
19	Satellite communication and navigation systems	Study of principles of construction of satellite communication and data transmission systems and their components; study of methods and types of multiple access, types of modulation and noise-immune coding; study of features and prospects of development of VSAT satellite networks; study of features of mobile satellite communication systems and television and radio broadcasting systems; study of parameters and characteristics of the most famous domestic and foreign satellite communication systems in geostationary and non-geostationary orbits; » study of promising satellite communication technologies; study of satellite navigation systems.	**5**						**v**	
20	Satellite and radio relay systems	The purpose of studying the discipline is modern and promising directions of development of radio relay and satellite equipment, characteristics of modern methods of	**5**						**v**	

		modulation of digital signal processing used in radio relay and satellite equipment, operating conditions of radio relay and satellite communication networks, applied methods of calculation and design of radio relay and satellite systems, electromagnetic compatibility of various radio communication and broadcasting systems.								
21	Internet of Things and Self-Organizing Networks	The course studies self-organizing networks, introduction to the concept of the Internet of Things, all-pervasive sensor networks, wireless self-organizing networks, and self-organizing networks for vehicles, as well as an overview of the main protocols for access control to the transmission medium, routing, and transport layer. Nodes that make up the network. These can be personal computers, laptops, smartphones, tablets, smart sensors, and other devices.	**5**			**v**				
22	Methods of modeling and optimization in infocommunication systems and networks	The purpose of studying the discipline is the main quality indicators of telecommunication networks and systems, the theory of mass service and the theory of teletraffic, the development of communication tools that provide communication between end user devices, mobile and landline phones, personal computers, smartphones. The interaction of these devices allows implementing the processing of information flows for various purposes. Analog models are considered in depth among physical models. Mathematical models that are created to compile and study models of objects or processes.	**5**				**v**			
23	Modern sensor technologies and applications	The objectives of the course are the main components of a stand-alone wireless sensor network (WSN wireless sensor network) are: a transceiver, a microcontroller, an external memory, a power supply, sensors and an antenna a. Digital signal processors can be selected for broadband wireless communication. Possible wireless transmission options can be radio frequency (RF), optical (laser) and infrared	**4**							**v**

		transceivers								
24	Components of an optical communication system	The purpose of the course is to study data transmission systems via optical fiber (cable), using active network equipment and passive optical components. Optical connectors and pass-through adapters are used to connect two connectors in fiber-optic communication lines (FOCL); attenuators are used to introduce additional attenuation into the optical line. They are also used to avoid overloading the receiving module of active equipment; passive optical spectral multiplexers xWDM allow to significantly increase the throughput of the fiber-optic line.	**5**						**v**	
25	Embedded microcontrollers and microprocessors of the system	The article presents basic information about modern microprocessors and microcontrollers, provides architectures and classifications of modern microprocessors and microcontrollers, command systems and their comparative characteristics. Considerable attention is paid to large integrated circuits that complement microprocessors (timers, direct memory access controllers, serial transceivers, etc.). Typical microprocessor systems are highlighted. Methods and techniques for designing a microcontroller and microprocessor are given. The principles of operation of microprocessor control tools are described.	**5**						**v**	
26	Wireless sensor networks	Understand the principles and technologies used in wireless sensor networks, including different types of sensor nodes, communication protocols, and architectures. Consider security and data protection issues in wireless sensor networks, including threats and methods to prevent them. Support the stimulation of research and innovation in the field of wireless sensor networks so that graduate students can develop new technologies and improve existing systems. Studying this course helps graduate students	**5**			V				

		master modern technologies and practices in the field of wireless sensor networks, which can be useful in the development and implementation of sensor systems in various fields, as well as in research and innovation in this field.								
27	Multimedia technologies in telecommunication systems	This discipline examines modern technologies for processing and transmitting video, audio and other multimedia information, digital processing and compression of video and audio information, studies statistical and perceptual redundancy of video and audio information, as well as methods for its elimination, studies the principles and standards of video and audio compression, methods for their calculation, restoration of compressed video and audio information, and assessment of its quality.	**5**			V				
28	Telemetric infocommunication systems	The purpose of studying the discipline is to build transmission systems with frequency division multiplexing (FDM). Methods of forming and transmitting channel signals in FDM transmission systems. Principles of building transmission systems with time division multiplexing (TDM). Hierarchical construction of PCM systems. Principles of building terrestrial and satellite television and sound broadcasting systems.	**5**		V	V				
28	Design and modeling of electronic devices	This course is aimed at studying the design methods of integrated circuits and microchips, as well as their practical application. Students master the development, modeling and functional verification of analog and digital circuits. Free and accessible software such as KiCad, LTspice, Qucs-S, Logisim are used for design and simulation. FPGA design tools are also used, including Xilinx Vivado WebPACK and Intel Quartus Prime Lite.	**5**			V		V		

		As a result of mastering the course, practical skills in designing, modeling and testing integrated circuits and microchips are formed.								

5. Curriculum of the educational program

ELC262	Modern Sensor Technologies and Applications	3	PD, CCH	5	150	30/0/15	105	E	5				
ELC256	Programming the microcontroller		PD, UC	5	150	30/15/0	105	E		5			ELC171
ELC204	Multimedia technology in telecommunication systems	1	PD, CCH	5	150	30/0/15	105	E		5			ELC144, ELC151
ELC213	Telemetry information and communication systems	1	PD, CCH	5	150	30/0/15	105	E		5			
ELC252	Computer-aided design system in radio electronic devices		PD, UC	5	150	30/0/15	105	E			5		
ELC211	Satellite and radio relay systems	2	PD, CCH	5	150	30/0/15	105	E			5		ELC147
ELC212	Satellite communication and navigation systems	2	PD, CCH	5	150	30/0/15	105	E			5		
ELC254	Wireless sensory networks	3	PD, CCH	5	150	30/0/15	105	E			5		
ELC257	Embedded microcontrollers and microprocessors of the system	3	PD, CCH	5	150	30/0/15	105	E			5		
ELC296	Fundamentals of optical and radar systems for remote sensing of the Earth		PD, UC	4	120	30/0/15	75	E				4	
M-4. Practice-oriented module													
AAP256	Research practice		PD, UC	4				R				4	
M-5. Experimental research module													
AAP268	Research work of a master's student, including internship and completion of a master's thesis		RWMS	4				R	4				
AAP268	Research work of a master's student, including internship and completion of a master's thesis		RWMS	4				R		4			
AAP251	Research work of a master's student, including internship and completion of a master's thesis		RWMS	2				R			2		
AAP255	Research work of a master's student, including internship and completion of a master's thesis		RWMS	14				R				14	
M-6. Module of final attestation													
ECA212	Registration and protection of the master thesis		FA	8								8	
Total based on UNIVERSITY:									30	30	30	30	
									60		**60**		

Number of credits for the entire period of study

Cycle code	Cycles of disciplines	Credits			
		Required component (RC)	University component (UC)	Component of choice (CCH)	Total
GED	Cycle of general education disciplines	0	0	0	0
BD	Cycle of basic disciplines	0	20	15	35
PD	Cycle of profile disciplines	0	23	30	53
Total for theoretical training:		**0**	**43**	**45**	**88**
RWMS	Research Work of Master's Student				24
ERWMS	Experimental Research Work of Master's Student				0
FA	Final attestation				8
TOTAL:					**120**

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Minutes № 3 dated 20.12.2024

Decision of the Academic Council of the Institute. Minutes № 4 dated 22.11.2024

Signed:

Governing Board member - Vice-Rector for Academic Affairs	Uskenbayeva R. K.
Approved:	
Vice Provost on academic development	Kalpeyeva Z. Б.
Head of Department - Department of Educational Program Management and Academic-Methodological Work	Zhumagaliyeva A. S.
acting Director of Institute - Institute of Automation and Information Technologies	Chinibayev Y. Г.
Department Chair - Electronics, telecommunications and space technologies	Tashtay Y. .
Representative of the Academic Committee from Employers ____Acknowledged____	Bekenov E. E.