Ministry of Agriculture of the Republic of Kazakhstan

JSC "Kazakh Agrotechnical Research University named after S.Seifullin"

Faculty of «Energy»

Department «Radio engineering, electronics and telecommunication»

I APPROVE
Dean of the Energy Faculty Office
Issenov S.S
(Signature) (Full name)
«28» 06 2024y.

7M06204
(Cipher Educational programs)

Multiservice telecommunication technologies
(Name Educational programs)

CATALOG ELECTIVE DISCIPLINE

2024 years
receipts

ASTANA, 2024

Catalog elective disciplines of the OP
developed on basis worker curriculum OP «Multiservice telecommunication technologies».

Catalog elective disciplines discussed on meeting departments «Radio engineering, electronics and telecommunication»

protocol № 13 from «23» 05 2024 y.

Catalog elective disciplines reviewed on meeting Faculty Council on Academic Quality

protocol № 15 from «21» 06 2024 y.

Head of Department department	signature	Puraye P. PhD, ass prof Full name, rank, degree
Chairman of the SFAK	signature	Zhantlessova AB. Full name, rank, degree

Introduction

Dear student (master's student, doctoral student)!

Before you is the Catalogue of Elective Subjects. This is a systematized annotated list of elective academic subjects. It was developed for the purposes of providing the opportunity for independent, prompt, flexible and comprehensive formation of an individual learning path. This is your assistant in creating your individual curriculum. With the credit technology of education, all academic disciplines are divided into 3 cycles - General Education (GED), Basic (BD) and Profiling (PD). Within each of these cycles, academic disciplines are divided into 2 types - Compulsory Component and Elective Component (elective, i.e., elective academic disciplines). The compulsory component disciplines are established by the State Compulsory Education Standard and are studied by all students of this educational program without exception . Elective academic disciplines are offered to you for study by departments. Your advisor will help you choose elective academic disciplines.

Contents

1. MAIN TERMS AND THEIR DEFINITIONS

An educational program is a single set of basic characteristics of education, including the goals, results and content of training, the organization of the educational process, the methods and techniques of their implementation, and the criteria for assessing the results of training.

The content of the educational program of higher education consists of disciplines of three cycles – general education disciplines (hereinafter – GED), basic disciplines (hereinafter – BD) and specialized disciplines (hereinafter – PD).

The cycle of the educational course includes disciplines of the compulsory component (hereinafter referred to as OC), the university component (hereinafter referred to as VC) and/or the elective component (hereinafter referred to as EC). The BD and PD include disciplines of VC and EC.

The working curriculum (hereinafter referred to as WCP) is an educational document developed by the OVPO independently. based on the educational program and individual educational plans of students;

The Catalogue of Elective Disciplines (CED) is a systematized annotated list of all disciplines of the elective component for the entire period of study, containing their brief description indicating the purpose of study, brief content (main sections) and expected learning outcomes. The CED reflects the prerequisites and postrequisites of each academic discipline. The CED should provide students with the opportunity to choose alternative elective academic disciplines to form individual educational trajectory. Based on the educational program and the KED, students develop individual educational plans with the help of advisors .

Individual educational plan (hereinafter IEP) is a student's educational plan, independently formed by him for each academic year with the help of an advisor based on the educational program and the catalog of elective disciplines;

The mandatory component is a list of academic disciplines and the corresponding minimum volumes of academic credits established by the State Educational Standard and studied by students on a mandatory basis according to the curriculum;

University component (hereinafter referred to as UC) is a list of academic disciplines and corresponding minimum volumes of academic credits determined by the higher professional education institution independently for mastering the educational program;

Elective component – a list of academic disciplines and corresponding minimum amounts of academic credits, proposed by the OVPO independently chosen by students in any academic period, taking into account their prerequisites and postrequisites ;

Elective disciplines – academic disciplines included in the university component and the elective component within the established academic credits and introduced by the Higher Professional Education Department, reflecting the individual preparation of the student, taking into account the specifics of socio-economic development and the needs of a particular region, and established scientific schools.

Prerequisites (Prerequisite) (prerequisite) – disciplines and (or) modules and other types of academic work containing knowledge, abilities, skills and competencies necessary for mastering the studied discipline and (or) modules;

Post-requisites (Postrequisite) (postrequisite) – disciplines and (or) modules and other types of academic work, the study of which requires knowledge, abilities, skills and competencies acquired upon completion of the study of a given discipline and (or) module;

Learning outcomes are the volume of knowledge, skills, and abilities acquired and demonstrated by the student in mastering the educational program, as confirmed by the assessment, and the values and attitudes formed;

Advisor - a teacher who performs the functions academic mentor of a student in the relevant educational field program, providing assistance in choosing a learning path (formation of an individual curriculum) and mastering the educational programs during the training period;

The register of educational programs is the information system "Unified Platform for Higher Education" (hereinafter referred to as the information system) of the authorized body in the field of science and higher education, which includes a list of educational programs developed by organizations of higher and (or) postgraduate education.

Competencies are the ability to practically use the knowledge, skills and abilities acquired during the learning process in professional activities.

2. STRUCTURE KED

2.1 Catalog elective disciplines, contains next information:
- Cycle disciplines;
- Discipline code ;
- Name disciplines;
- Semester of study (semesters of study of prerequisite and postrequisite disciplines should not coincide with semesters of study of the discipline itself);
- Quantity loans;
- Prerequisites ;
- Post-requisites;
- Brief description of the discipline;
- Expected learning outcomes.

Cycle	Disc code	Name disc	Semeste r	Number of credits	Departm ent	Prerequisites	Post-requisites	Brief description of the discipline	Expected learning outcomes
KV	IYaP 5205	Foreign language (professional)	1	5	RET	Foreign language (bachelor's degree) , English for specific purposes , professionally oriented foreign language	The disciplines in the specialty are in English , and academic writing.	Forms foreign language communicative competence as a significant component of professional competence and the culture of scientific writing in students, allowing them to integrate into international scientific activities, allows them to freely operate the scientific and conceptual apparatus in their specialty, expand the scientific information base, master broad scientific knowledge, and identify promising areas of professional and scientific activity	RO 1 Proficiency in the state and foreign languages to the extent necessary to obtain information of professional content and to express one's ideas and options for solving professional problems in oral and written form. PO 3 Be competent in modern hardware for information security and their safe use in multi-service telecommunication technologies
KV	IFN 5205	History and philosophy of science	2	5	RET	History and philosophy of science , psychology of management	NIRM . EIRM.	Introduction. Basic provisions and concepts of probability theory and mathematical statistics. Theory of random errors. Processing of experimental data of measurement results. Statistical processing of experimental research results. Methods of graphic processing of experimental research results.	RO 4 Demonstrate readiness for scientific and pedagogical activities and for further independent learning RO 5 To form a natural-scientific worldview necessary for the full development of the individual in the social and professional spheres PO 3 Be competent in modern hardware for information security and their safe use in multi-service telecommunication technologies

KV	PVSH 5205	Pedagogy of Higher Education	2	3	RET	Philosophy , political science and sociology , cultural studies and psychology	Teaching practice, implementation of teacher 's activities higher professional education and management of the pedagogical process	Allows master's students studying in the scientific and pedagogical direction to understand the general problems, methodological and theoretical foundations of higher education pedagogy, skills for analyzing training and education, elements of modern planning and organization technologies.	RO 4 Demonstrate readiness for scientific and pedagogical activities and for further independent learning RO 5 To form a natural-scientific worldview necessary for the full development of the individual in the social and professional spheres PO 3 Be competent in modern hardware for information security and their safe use in multi-service telecommunication technologies
KV	PU 5205	Psychology of Management	5	2	RET	Philosophy , political science and sociology , cultural studies and psychology	Teaching practice , and research practice , psychological support of management activities; methods of working with functional states in the activities of a manager , methodological foundations of scientific research	Develops skills in managing organized human activities through the study of psychological laws and patterns of management and quality of work, develops the ability to make scientifically sound decisions, structure the actions of other people, and manage an organization.	RO 4 Demonstrate readiness for scientific and pedagogical activities and for further independent learning RO 5 To form a natural-scientific worldview necessary for the full development of the individual in the social and professional spheres PO 3 Be competent in modern hardware for information security and their safe use in multi-service telecommunication technologies
KV	AP 6318	Academic writing	4	3	RET	English for Specific Purposes	Specialized courses in English	The course is aimed at developing and improving academic skills in written English, necessary for successful written communication in academic, professional and work settings. Students are introduced to the features of academic writing, using library catalogs and	RO 1 Proficiency in the state and foreign languages to the extent necessary to obtain information of professional content and to express one's ideas and options for solving professional problems in oral and written form.

								websites. Practice writing a discursive essay: plan, main idea, paragraphs and conclusion. Paraphrasing methods. APA format: references and citations. Students study types of abbreviations, academic vocabulary, and the use of articles.	PO 6 Be competent in modern issues of multiservice telecommunication technologies according to the Atlas of New Professions of the Republic of Kazakhstan. Be competent in current issues of modern multiservice telecommunication technologies, ready to independently conduct research, analyze and process results in the design, development and modeling of multiservice telecommunication networks using new technical solutions taking into account modern systems and technologies. RO 11 Apply theoretical and practical knowledge to solve educational, practical and professional problems in the studied area; know the basics and methods of scientific research, academic writing and apply them in the studied area; understand the meaning of the principles and culture of academic honesty
KV	AYa DAC 632 1	English for Academic Purposes	4	3	RET	Foreign language / Prof. English	Completion of a master's thesis	Comprehensive theoretical-linguistic, practical and information-analytical training for the purpose of performing functions related to the use of a foreign language in professional and scientific	PO 1 Proficiency in the state and foreign languages to the extent necessary to obtain information of professional content and to express one's ideas

								activities: mastery of public speaking skills, conducting a discussion, the ability to work with information from various sources, and edit texts of professionally significant content in a foreign language.	and options for solving professional problems in oral and written form. PO 6 Be competent in modern issues of multiservice telecommunication technologies according to the Atlas of New Professions of the Republic of Kazakhstan. Be competent in current issues of modern multiservice telecommunication technologies, ready to independently conduct research, analyze and process results in the design, development and modeling of multiservice telecommunication networks using new technical solutions taking into account modern systems and technologies. RO 11 Apply theoretical and practical knowledge to solve educational, practical and professional problems in the studied area; know the basics and methods of scientific research, academic writing and apply them in the studied area; understand the meaning of the principles and culture of academic honesty
KV	MONI5206	Methodological foundations of scientific research	5	2	RET	History and philosophy of science , psychology of management	NIRM . EIRM.	Review of the main directions of scientific research development in Kazakhstan and abroad. Methodology and methods of scientific research. Selection of the direction of scientific research and stages of	RO 11 Apply theoretical and practical knowledge to solve educational, practical and professional problems in the studied area; know the basics and methods

								scientific research work. Processing of experimental research results. Registration of scientific work results and transfer of information. Implementation and effectiveness of scientific research. Scientific organization of intellectual work. Basic principles of research group management.	of scientific research, academic writing and apply them in the studied area; understand the meaning of the principles and culture of academic honesty PO 4 Demonstrate readiness for scientific and pedagogical activities and for further independent learning. PO 5 To form a natural scientific worldview necessary for the full development of the individual in the social and professional spheres. PO 3 Be competent in modern hardware for information security and their safe use in multi-service telecommunication technologies PO 7 Demonstrate the ability to use specialized methods of modeling, design, simulation, testing in the field of radio engineering, electronics and telecommunications
KV	TPTE 5210	Theory and practice of technical experiment	5	2	RET	History and philosophy of science , psychology of management	NIRM . EIRM.	Introduction. Basic provisions and concepts of probability theory and mathematical statistics. Theory of random errors. Processing of experimental data of measurement results. Statistical processing of experimental research results. Methods of graphic processing of experimental research results.	PO 1 1 Apply theoretical and practical knowledge to solve educational, practical and professional problems in the studied area; know the basics and methods of scientific research, academic writing and apply them in the studied area; understand the meaning of the principles and culture of academic honesty

									PO4 Demonstrate readiness for scientific and pedagogical activities and for further independent learning. PO 5 To form a natural scientific worldview necessary for the full development of the individual in the social and professional spheres. PO 3 Be competent in modern hardware for information security and their safe use in multi-service telecommunication technologies PO 7 Demonstrate the ability to use specialized methods of modeling, design, simulation, testing in the field of radio engineering, electronics and telecommunications
KV	IMOS 5314	Intelligent methods of signal processing	5	1	RET	Digital signal processing, fundamentals of digital and microprocessor technology, programmable logic integrated circuits	Combined systems, intelligent robotics	Biological neuron; Artificial neuron model; Neural network model – fully connected multilayer perceptron; Algorithms for training neural networks, training ANN with or without a teacher; Modern types of ANN used in solving practical problems: recurrent networks, spike networks, generative adversarial networks, convolutional networks and others; Implementation of ANN on FPGA, generation of Verilog code of neural network from Python libraries; Algorithms for parallel execution of neural computations on FPGA; Preliminary signal processing and preparation of a training	

								database for ANN.	
KV	APR APLI SP 530 1	Hardware and software implementation of algorithms on programmable logic integrated circuits (FPGA)	4	1	RET	Engineering Mathematics, Theory of Electrical Circuits 1, Electronics and Circuit Engineering 1.2, Digital Devices and Microprocessor Technology 1.2	Modeling and optimization of telecommunication systems and networks .	Mathematical foundations of coding. Models of codes and coding systems. Information characteristics of digital communication systems. Algebraic methods of coding and decoding in the spectral domain. Chase algorithms, decoding with natural output, by maximum a posteriori probability, Log -MAP, Max-Log -MAP, OSD. Software implementation of algorithms for error-correcting coding on MATLAB and ModelSim . Software and hardware implementation of the FPGA and SNC debug board decoder.	PO 2 Carry out innovative engineering projects for the development of hardware and software for radar, radio navigation and space systems using modern methods and automated design systems, advanced development experience and competitive products. PO 6 Be competent in modern issues of multiservice telecommunication technologies according to the Atlas of New Professions of the Republic of Kazakhstan. Be competent in current issues of modern multiservice telecommunication technologies, ready to independently conduct research, analyze and process results in the design, development and modeling of multiservice telecommunication networks using new technical solutions taking into account modern systems and technologies. PO 7 Demonstrate the ability to use specialized methods of modeling, design, simulation, testing in the field of radio engineering, electronics and telecommunications

									PO 9 Demonstrate knowledge of modern achievements in the field of creation, operation and development prospects of multiservice telecommunication systems and communication networks
KV	PSO D 530 1	Microwave and optical devices	5	1	RET	Architecture of networks and telecommunication systems	Methods of ensuring electromagnetic compatibility of radio-electronic equipment , digital television and radio broadcasting systems.	Review of microwave technology development. Brief theory of slow-wave systems. Design and operating principle of transit and reflective klystrons. Design and operating principle of traveling and backward wave tubes. Design and physics of Gunn diode operation, Gunn diode generators, its amplifying properties. Bipolar and field-effect transistors. Lasers.	RO 4 Demonstrate readiness for scientific and pedagogical activities and for further independent learning. PO 6 Be competent in modern issues of multiservice telecommunication technologies according to the Atlas of New Professions of the Republic of Kazakhstan. Be competent in current issues of modern multiservice telecommunication technologies, ready to independently conduct research, analyze and process results in the design, development and modeling of multiservice telecommunication networks using new technical solutions taking into account modern systems and technologies PO 8 Be able to independently solve problems related to the design and operation of multi-service telecommunication systems and networks, perform calculations and reasonably select the

									necessary equipment in accordance with the calculated and specified technical and economic data
KV	MO TSS 630 1	Modeling and optimization of telecommunication systems and networks	5	3	RET	Methodological foundations of scientific research,	Methods of ensuring electromagnetic compatibility of radio-electronic equipment, digital television and radio broadcasting systems.	Basic concepts, principles, methods and techniques of modeling. Principles of constructing various telecommunication systems and networks. Programming packages in algorithmic languages of different levels for modeling physical processes and information flows in various telecommunication systems and networks. Algorithms for modeling information flows and physical processes accompanying them. Methods and tools for creating software shells for models of objects under study. Methods for calculating and monitoring the quality of information obtained from modeling results.	PO 2 Carry out innovative engineering projects for the development of hardware and software for radar, radio navigation and space systems using modern methods and automated design systems, advanced development experience and competitive products. PO 7 Demonstrate the ability to use specialized methods of modeling, design, simulation, testing in the field of radio engineering, electronics and telecommunications. PO 6 Be competent in modern issues of multiservice telecommunication technologies according to the Atlas of New Professions of the Republic of Kazakhstan. Be competent in current issues of modern multiservice telecommunication technologies, ready to independently conduct research, analyze and process results in the design, development and modeling of multiservice telecommunication networks using new technical solutions taking into account

									modern systems and technologies
KV	CST 631 5	Digital TV and Radio Broadcasting Systems	5	4	RET	Microwave and optical devices , methods of ensuring electromagnetic compatibility of radio-electronic equipment	Scientific and technical problems of RET , metrological support of telecommunication networks	Principles of digital television, high-quality and high-definition television systems, transmission of additional information, optical-electronic and electronic-optical conversion devices in television, transmission and distribution of digital television signals, transmission of television signals via radio channels, stereoscopic television systems	PO 2 Carry out innovative engineering projects for the development of hardware and software for radar, radio navigation and space systems using modern methods and automated design systems, advanced development practices and competitive products. PO 7 Demonstrate the ability to use specialized methods of modeling, design, simulation, testing in the field of radio engineering, electronics and telecommunications. PO 6 Be competent in modern issues of multiservice telecommunication technologies according to the Atlas of New Professions of the Republic of Kazakhstan. Be competent in current issues of modern multiservice telecommunication technologies, ready to independently conduct research, analyze and process results in the design, development and modeling of multiservice telecommunication networks using new technical solutions taking into account modern systems and technologies

KV	VSU 631 6	Embedded and touch devices	4	4	RET	Algorithmization and programming in high-level languages, digital devices and microprocessor technology 1,2.	Completion of a master's thesis	Cyber-physical approach. Architecture of embedded devices. Organization of interface and input-output systems in embedded devices and systems. Wired and wireless communication interfaces in embedded devices and systems. Operating modes of embedded devices and systems. Operating systems of embedded devices and systems. Security of embedded systems. Typical use of embedded devices and systems.	PO2 Carry out innovative engineering projects for the development of hardware and software for radar, radio navigation and space systems using modern methods and automated design systems, advanced development experience and competitive products. . PO 7 Demonstrate the ability to use specialized methods of modeling, design, simulation, testing in the field of radio engineering, electronics and telecommunications. PO 6 Be competent in modern issues of multiservice telecommunication technologies according to the Atlas of New Professions of the Republic of Kazakhstan. Be competent in current issues of modern multiservice telecommunication technologies, ready to independently conduct research, analyze and process results in the design, development and modeling of multiservice telecommunication networks using new technical solutions taking into account modern systems and technologies PO 8 Be able to independently solve problems related to the design and operation of

									multi-service telecommunication systems and networks, perform calculations and reasonably select the necessary equipment in accordance with the calculated and specified technical and economic data
KV	MO ESR S 631 2	Methods of ensuring electromagnetic compatibility of radio-electronic equipment	5	4	RET	Hardware and software implementation of algorithms on programmable logic integrated circuits (FPGA)	Master's thesis	General information on unintentional interference. Additive and multiplicative interference. Fundamentals of EMC prediction. Sources and receptors of electromagnetic interference. Balance equation between interference immunity and interference emission. Information measure of proximity-divergence of two signals (interference). Classification of problems of optimal assignment of radio frequencies. Radiation of radio transmitters.	PO2 Carry out innovative engineering projects for the development of hardware and software for radar, radio navigation and space systems using modern methods and automated design systems, advanced development experience and competitive products. PO7Demonstrate the ability to use specialized methods of modeling, design, simulation, testing in the field of radio engineering, electronics and telecommunications. PO 6 Be competent in modern issues of multiservice telecommunications technologies according to the Atlas of New Professions of the Republic of Kazakhstan. Be competent in current issues of modern multiservice telecommunications technologies, ready to independently conduct research, analyze and process results in the design, development and modeling of multiservice

									telecommunications networks using new technical solutions taking into account modern systems and technologies PO 8 Be able to independently solve problems related to the design and operation of multi-service telecommunication systems and networks, perform calculations and reasonably select the necessary equipment in accordance with the calculated and specified technical and economic data
KV	BKKS 5213	Security and privacy of cyber-physical systems	5	1	RET	Algorithms and their complexity, relational database design, computer networks , cryptography.	Master's thesis	Introduction to CPS security and privacy. Key concepts in cyber-physical sources. Attack models for CPS. Security issues in the CPS world environment.	PO 3 Be competent in modern hardware for information security and their safe use in multi-service telecommunication technologies PO6 Be competent in modern issues of multi-service telecommunications technologies according to the Atlas of New Professions of the Republic of Kazakhstan. Be competent in current issues of modern multi-service telecommunications technologies, ready to independently conduct research, analyze and process results in the design, development and modeling of multi-service telecommunications networks using new

									technical solutions taking into account modern systems and technologies
KV	IB 521 3	Information security	5	1	RET	Algorithms and their complexity, relational database design, computer networks , cryptography.	Completion of a master's thesis	Terminological foundations of information security. General methodological principles of information security theory. Stages of information security development. Requirements for the information security system. Classification and analysis of information security threats. Causes, types, channels of information leakage and distortion. Functions and tasks of information security. Methods of forming security functions. Information security of the Republic of Kazakhstan.	PO 3 Be competent in modern hardware for information security and their safe use in multi-service telecommunication technologies PO6 Be competent in modern issues of multi-service telecommunications technologies according to the Atlas of New Professions of the Republic of Kazakhstan. Be competent in current issues of modern multi-service telecommunications technologies, ready to independently conduct research, analyze and process results in the design, development and modeling of multi-service telecommunications networks using new technical solutions taking into account modern systems and technologies
KV	KS 520 9	Converged networks	5	1	RET	Design and operation of telecommunication networks , packet and hybrid switching networks	Modeling and optimization of telecommunication systems and networks . NIRM. EIRM. LPWAN for the Internet of Things	The concept of a converged network. The term FMC The concept of a protocol Convergence of telecommunication networks NGN network, the basis of the NGN network Levels of the functional model of the NGN network Data storage. Providers Advantages of the NGN network and their difference from a traditional	PO 6 Be competent in modern issues of multiservice telecommunication technologies according to the Atlas of New Professions of the Republic of Kazakhstan. Be competent in current issues of modern multiservice telecommunication

								network. Self-similar traffic of multiservice networks. Models of distribution of multiservice traffic. Principles of traffic management in the core of the new generation transport network NGN.	technologies, ready to independently conduct research, analyze and process results in the design, development and modeling of multiservice telecommunication networks using new technical solutions taking into account modern systems and technologies. PO 7 Demonstrate the ability to use specialized methods of modeling, design, simulation, testing in the field of radio engineering, electronics and telecommunications RO 9 Demonstrate knowledge of modern achievements in the field of creation, operation and development prospects of multiservice telecommunication systems and communication networks
KV	ASST 5203	Architecture of networks and telecommunication systems	5	1	RET	Design and operation of telecommunication networks , packet and hybrid switching networks	Modeling and optimization of telecommunication systems and networks . NIRM. EIRM. LPWAN for the Internet of Things .	Main trends in the development of modern networks, direction of network development, general architecture of next-generation networks (NGN), problems of transition to a next-generation network, three-level NGN architecture on the IMS platform, main scenarios for transition to NGN.	PO6 Be competent in modern issues of multiservice telecommunication technologies according to the Atlas of New Professions of the Republic of Kazakhstan. Be competent in current issues of modern multiservice telecommunication technologies, ready to independently conduct research, analyze and process results in the design, development and modeling of multiservice telecommunication

									networks using new technical solutions taking into account modern systems and technologies. PO 7 Demonstrate the ability to use specialized methods of modeling, design, simulation, testing in the field of radio engineering, electronics and telecommunications RO 9 Demonstrate knowledge of modern achievements in the field of creation, operation and development prospects of multiservice telecommunication systems and communication networks
KV	MKM 6317	Machine-to-machine communications M2M	5	3	RET	Information security	Master's thesis	M2M Connection Protocols.Connection Protocols.M2M Communication Protocols. Connection Protocol Users. Choosing the Right M2M Communication Protocol. Wireless Technologies in Short Range Devices. Technologies for M2M with Limited Coverage. Technologies for M2M with Large Coverage. LPWA Wireless Technologies in IMT Systems. Wireless Technologies for Critical Applications.	RO 4 Demonstrate readiness for scientific and pedagogical activities and for further independent learning PO 6 Be competent in modern issues of multiservice telecommunication technologies according to the Atlas of New Professions of the Republic of Kazakhstan. Be competent in current issues of modern multiservice telecommunication technologies, ready to independently conduct research, analyze and process results in the design, development and modeling of multiservice telecommunication networks using new

									technical solutions taking into account modern systems and technologies PO 8 Be able to independently solve problems related to the design and operation of multi-service telecommunication systems and networks, perform calculations and reasonably select the necessary equipment in accordance with the calculated and specified technical and economic data
KV	LDIV 6308	LPWAN for the Internet of Things	5	3	RET	Wireless communication technologies , Internet of things , digital devices and microprocessor technology1 , antenna - feeder devices and radio wave propagation.	Systems engineering , in embedded and sensor devices.	IoT and IoE concept. LoRa modulation. LoRa and NB- IoT characteristics and frequency bands . Building an M2M/ IoT network based on NB- IoT technology . LoRaWAN architecture. Network server, device classes, scalability, Uplink and downlink messages. Gateways and nodes, antennas for LoRa . Building solutions and prototyping. Protocols: MQTT, HTTP integration. Modeling and data processing. Network localization and security. Large-scale network deployments.	PO 4 Demonstrate readiness for scientific and pedagogical activities and for further independent learning PO 6 Be competent in modern issues of multiservice telecommunications technologies according to the Atlas of New Professions of the Republic of Kazakhstan. Be competent in current issues of modern multiservice telecommunications technologies, ready to independently conduct research, analyze and process results in the design, development and modeling of multiservice telecommunications networks using new technical solutions taking into account modern systems and technologies

									PO 8 Be able to independently solve problems related to the design and operation of multi-service telecommunication systems and networks, perform calculations and reasonably select the necessary equipment in accordance with the calculated and specified technical and economic data