

Ministry of Agriculture of the Republic of Kazakhstan
Kazakh Agrotechnical Research University named after S.Seifullin

APPROVE
«S.Seifullin Kazakh Agrotechnical
Research University» NJSC
Chairman of the Board-Rector
_____ Tireuov K.M.

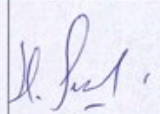
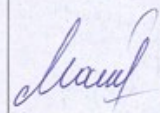
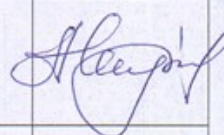
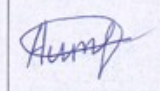
«__» ____ y., №__ protocol

EDUCATIONAL PROGRAM

6B06202 – «Radio engineering and electronics»
(name of the program)

The code and classification of the field of education:	6B06 Information and communication technologies
The code and classification of training areas:	6B062 Telecommunications
The code in the International Standard Classification of Education:	0714
Degree/qualification awarded: Bachelor / Specialist/Master/Doctor	Bachelor's Degree in Information and Communication Technology

Academic Committee:

№	Full name	Academic degree, academic title	Position at work	Place of work	Signature
1	Dunayev P.A.	PhD, Associate Professor	Head of the Department of Radio Engineering, Electronics and Telecommunications	«S.Seifullin KATRU» NJSC	
2	Manbetova Zh.D.	PhD	Acting Associate Professor - Senior Lecturer, Department of Radio Engineering, Electronics and Telecommunications	«S.Seifullin KATRU» NJSC	
3	Nabiyev N.K.	candidate of technical sciences	Senior Lecturer, Department of Radio Engineering, Electronics and Telecommunications	«S.Seifullin KATRU» NJSC	
4	Mirmanov A.B.		Associate Professor, Department of Radio Engineering, Electronics and Telecommunications	«S.Seifullin KATRU» NJSC	
5	Aitkulov N.S.		Master's degree graduate, Department of Radio Engineering, Electronics and Telecommunications	«S.Seifullin KATRU» NJSC	
6	Kenzhebulatov D.B.		3rd year student, group 08-059-21-13, department "Radio engineering, electronics and telecommunications"	«S.Seifullin KATRU» NJSC	

Agreed with representatives of employers:

№	Full name	Position at work	Place of work	Signature
1	Tukushev N.B.	Chief Project Manager	DCB Business Development Services – Corporate Business Division – branch of «Kazakhtelecom» JSC	
2	Myalo M.V.	Head of the Central Service of Dispatch and Technological Control Facilities (CSDTCF)	«Akmola Distribution Electricity Grid Company» JSC	

The Academic Committee was approved by the order of the Chairman of the Board - Rector of «S.Seifullin KATRU» NJSC

«17» 12 2024 y., №435-H protocol

The Academic Committee was approved by the order of the Chairman of the Board-Rector of «S.Seifullin KATRU» NJSC

«17» 12. 2024 y., № 435-H protocol

Educational program 6B06202 – «Radio engineering and electronics»
(code and name of the program)

Reviewed on:

at the meeting of the department «Radio engineering, electronics and telecommunications»

«__» _____ 20__ y., №__ protocol

at the meeting of the Faculty Council on Academic Quality

«__» _____ 20__ y., №__ protocol

at the meeting of the Academic Council of the University

«__» _____ 20__ y., №__ protocol

Date of update «__» _____ 20__ y.

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1 Passport of the educational program

1.1 Objective of the educational program

Professional training of highly qualified specialists with a competitive level of knowledge in accordance with the level of development of technology and engineering in the field of radio engineering and electronics, skills and professional abilities in the field of current areas, with the necessary professional and personal competencies sufficient for successful activities at enterprises of the republic and beyond.

The resulting learning outcomes:

LO 1 Apply theoretical knowledge in solving the problems of designing electronic and infocommunication systems, preparing for the workflow for the manufacture of radio engineering and electronic devices.

LO 2 To develop students' competencies in economics, law and innovative entrepreneurship, the basics of anti-corruption culture, ecology, the basics of life safety and the Sustainable Development Goals (SDGs), as well as the basics of artificial intelligence and scientific research in the field of telecommunications, with an emphasis on the development of inclusive thinking, respect for diversity and the principles of equal opportunities for all.

LO 3 To know the state language and one foreign language for providing and documenting of information, to be able to use the normative and legal documentation, typical for the field of information and communication technologies and communication systems, to be ready to read the project and working technical documentation.

LO 4 Demonstrate knowledge of modern technologies, standardization requirements, metrological support and life safety in the development and operation of radio engineering devices and infocommunication systems, ensure quality control of manufactured radio engineering and electronic devices.

LO 5 To possess deep knowledge in the field of natural-mathematical sciences and history.

LO 6 Demonstrate knowledge of the basics of design and installation, be able to operate radio engineering and infotelec communication devices and systems, master methods for calculating electrical circuits, perform maintenance of complex functional components of electronic equipment, routine repairs and post-repair of complex functional components of electronic equipment.

LO 7 To be able to carry out calculations for the design of systems and networks of telecommunications, to use modern software packages of computer programs for calculations, modeling and automation of design of radio electronic devices and systems of telecommunications.

LO 8 Know the basics of radio electronic circuits and signals, radiation, propagation and reception of radio waves, distinguish between types of antenna-feeder devices, know wireless and wired communication technologies and have an idea of their differences, be able to calculate radio and electronic devices.

LO 9 To possess a deep level of knowledge in the field of analog and digital electronic technologies, to have experience in circuit modeling, to demonstrate knowledge in the field of microprocessor systems and to possess the skills of programming microcontrollers.

LO 10 To possess profound knowledge of information and computer technologies, the basics and elemental base of telecommunications used in professional activities.

LO 11 Have knowledge of the theory of electrical and digital communications, about the methods, principles of operation of devices for processing and converting data transmission signals.

Regulatory framework

- Constitution of the Republic of Kazakhstan.
- Law of the Republic of Kazakhstan dated July 27, 2007 No. 319-III “On Education” (as amended and supplemented as of 01.05.2023).
- Order of the Minister of Science and Higher Education of the Republic of Kazakhstan dated July 20, 2022 No. 28916 “On approval of state compulsory standards of higher and postgraduate education”.
- National Qualifications Framework of 16.03.2016.
- Sectoral qualifications framework “TELECOMMUNICATIONS” No. 102-XT dated July 29, 2019.
- Atlas of new professions of the Republic of Kazakhstan (<https://atlasbt.enbek.kz/industry/4>).
- Professional standard:
 1. Manufacture of electrical and radio engineering, electronic products (1.03.2024 y.), <https://adilet.zan.kz/rus/docs/G24IS000084#z1788>.

Production unit

Department of Radio Engineering, Electronics and Telecommunications

2 General characteristics of the educational program

Nowadays, it is difficult to imagine a field of science and technology that does not use the achievements of radio engineering and electronics. These achievements are not only radio and television broadcasting, but also mobile, space and satellite communications, computer radio electronics, smart home based on wireless technologies, the Internet of Things, control systems for land, sea and air transport, etc. Telemetry systems, ground, air and space-based radar systems and communication systems based on digital technologies are rapidly developing. Graduates of the educational program "Radio Engineering and Electronics" of the new level will have competitive advantages over other technical specialties.

The educational program "Radio Engineering and Electronics" is developed in accordance with the National Qualifications Framework and is aligned with the Dublin Descriptors and the European Qualifications Framework. The educational program is designed on the basis of a modular system of studying disciplines and contains modules that form general cultural and professional competencies.

The educational program "Radio Engineering and Electronics" includes the study of the following cycles:

- theoretical training in cycles of general education, basic and specialized disciplines,
- additional types of training: military training, etc.;
- final state certification in the form of passing a state exam in the specialty and a comprehensive exam/preparation and defense of a bachelor's thesis.

Standard period for mastering the educational program for full-time education is 4 years. The complexity of mastering the educational program "Radio Engineering and Electronics" by a student, indicated in credits for the entire period of study in accordance with the State Educational Standard of the Republic of Kazakhstan in the field of training 6B062 Telecommunications, including all types of classroom and independent work of the student, practice, and the time allocated for quality control for full-time education is 240 credits.

3 Competency model (portrait) of a graduate

3.1 Areas of professional activity

The sphere of professional activity is 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, the transformation of information, and the management of technological processes in various areas of the national economy.

3.2 Types of professional activity

A graduate of the educational program "Radio Engineering and Electronics" can perform the following types of professional activities:

- production and technological;
- service and operational;
- organizational and managerial;
- installation and commissioning;
- calculation and design;
- experimental research.

3.3 General educational competencies

- have an idea of the role of science and education in public life, of modern trends in the development of scientific knowledge, of current methodological and philosophical problems of the natural sciences,
- know the methodology of scientific knowledge, the principles and structure of the organization of scientific activity,
- possess psychological methods and means of improving the efficiency and quality of training;
- know the psychology of students' cognitive activity in the learning process,
- possess the skills to use the acquired knowledge for the original development and application of ideas in the context of scientific research,
- be able to critically analyze existing concepts, theories and approaches to the analysis of processes and phenomena.

3.4 Basic competencies

In accordance with general personal knowledge, skills and abilities, and competencies, a bachelor must:

- apply basic knowledge when solving problems of calculation, modeling, design of radio engineering and electronic systems and devices;
- programming of technological processes for the operation of electronic devices in various areas of industry and the agro-industrial complex.
- to present a scientific picture of the world, adequate to the modern level of knowledge, based on fundamental laws and methods of physical and mathematical phenomena;
- identify the natural scientific essence of problems arising in the course of professional activity and the ability to solve them using the appropriate physical and mathematical apparatus;
- solve problems of analysis and calculation of electrical circuits;
- apply modern means of displaying and editing technological drawings during the preparation of design and technological documentation;
- use basic methods of processing and presenting experimental data;

- carry out search, storage, processing and analysis of information from various sources, databases and present it in a timely manner in the required format, based on information, computer and network technologies;
- use modern trends in the development of electronic, measuring and computing technology, as well as the latest information technologies in their professional activities;
- navigate the selection of materials, elements and electronic devices, taking into account their physical and operational characteristics, during the design and creation of electronic systems and devices.
- use computer skills, be proficient in information technology methods, and comply with basic information security requirements.

3.5 Professional competencies Bachelor's degrees are formed by the ability to:

- select circuits for analog and digital electronic devices, perform circuit calculations and draw up schematic diagrams taking into account implementation in integrated design;
- conduct modeling, theoretical and experimental research of newly developed units and devices, using modern methods of analysis and synthesis;
- analyze the structure and capabilities of the main systems for transmitting and converting information about objects and systems;
- carry out reliability analysis and diagnostic schemes of radio engineering and electronic devices, select the necessary sensors;
- carry out reliability analysis and diagnostic schemes of radio engineering and electronic devices, select the necessary sensors;
- perform calculations related to the selection of parameter values for electronic elements, optimization of these parameters and operating modes using computer technology and programming;
- develop the structure of radio engineering and electronics devices, design radio electronic systems and devices;
- carry out verification, adjustment, regulation, assessment of the condition of equipment and configuration of software used for the development, production and configuration of radio engineering devices and systems;
- carry out installation, adjustment, testing and commissioning of prototypes of parts, units, systems and products of radio engineering devices and systems;
- carry out operation and maintenance of radio-electronic equipment;
- carry out repair and adjustment of radio-technical devices for various purposes;
- select circuits for analog and digital electronic devices, perform circuit calculations and draw up schematic diagrams taking into account implementation in integrated design;
- conduct modeling, theoretical and experimental research of newly developed units and devices, using modern methods of analysis and synthesis;
- analyze the structure and capabilities of the main systems for transmitting and converting information about objects and systems;
- develop devices for storing and displaying information based on software and hardware;
- comply with the requirements of standardization and metrological support during design;
- analyze and coordinate the technical specifications for the design of the device being developed;
- prepare scientific and technical documentation on the work performed.

4. Base for professional practice

The educational practice involves studying standard packages of applied programs for solving practical problems; using basic methods of processing experimental data, checking, adjusting and adjusting equipment and setting up software, acquiring skills in working with measuring instruments and methods of processing the results of experimental studies.

Educational practice is carried out in the first year in the department's laboratories.

Industrial practice aims to systematize, expand and consolidate professional knowledge, develop students' skills in conducting independent scientific work, research and experimentation, as well as create a theoretical and experimental basis for the high-quality completion of the final qualifying (diploma) work and its defense.

It is envisaged that students will undergo educational, industrial, and pre-graduation practice.

Places for internship may include telecommunications operators, research and development organizations, industrial enterprises and universities equipped with modern telecommunications equipment, measuring and computer technology.

The internship is conducted at the following major enterprises in the field of information and telecommunication technologies and electronics in the Republic of Kazakhstan:

1. JSC "Nursultan Nazarbayev International Airport";
 2. Branches of JSC "Transtelecom", RK;
 3. Public Organization "Kazakhstan Federation of Radio Sports and Amateur Radio" Astana city;
 4. TOO "Ulttyk Telecom", Astana;
 5. Branches of JSC "Kazakhtelecom", RK;
 6. JSC Astana-Regional Electric Grid Company, Astana city. JSC "NC "Kazakhstan" Temir Zholy", Astana;
 8. LLP "Digital system service", Astana;
 9. LLP "Halyk Telecom" Astana;
 10. Sputnik Service 2007 LLP, Astana;
 11. JSC NK KTZ GCUS, Astana;
 12. Branch of JSC "Industrial Construction Telephone Company" Bitelecom - Akmola PMC communications;
 13. ClubRobotek, Astana;
 14. JSC Energoinform, Astana;
 15. LLP CentralAsiaTelecom, Astana;
 16. LLP "MBit", Astana;
 17. RTRK "Kazakhstan", Astana;
 18. LLP "KazMedia Center", Astana;
 19. "Allem" Engineering Company LLP, Astana;
 20. LLP "Astana Electrotechnical Plant", Astana;
 21. JSC "Astel", Astana;
 22. National Security Committee OF THE Republic OF Kazakhstan.
- The specified organizations and enterprises as a practice base include most of the objects of professional activity for the future specialist.
- Internships can be conducted in the following divisions of these enterprises:
- areas of operation of telecommunication systems;
 - areas for adjustment and assembly of devices, means and systems of communication and television and radio broadcasting;
 - sections for product control and computer methods for measuring parameters, troubleshooting of communication equipment;
 - control and measuring departments or laboratories for testing communication equipment and systems;
 - development departments and design departments.

When assigning students to internships, preference is given to enterprises offering jobs for students after graduation and to enterprises with which contractual or business relations have been established.

5 Structure of the educational program

No.	Name of cycles and disciplines	Total labor intensity	
		in academic hours	in academic credits
1	2	3	4
1	Cycle of general education disciplines (GED)	1680	56
1)	Required component	1530	51
	History of Kazakhstan	150	5
	Philosophy	150	5
	Foreign language	300	10
	Kazakh (Russian) language	300	10
	Information and Communication Technologies (in English)	150	5
	Cultural studies and psychology	120	4
	Political Science and Sociology	120	4
	Physical culture	240	8
2)	University component	150	5
	Economics, law and innovative entrepreneurship	150	5
2	Cycle of basic disciplines (BD)	3090	103
1)	University component	3000	100
	Mathematics I	150	5
	Physics	150	5
	Mathematics II	150	5
	Engineering Mathematics	120	4
	Algorithmization and programming in high-level languages	90	3
	Educational practice	60	2
	Industrial practice	360	12
	Electrical Circuit Theory 1	150	5
	Electrical Circuit Theory 2	150	5
	Digital devices and microprocessor technology 1	150	5
	Electronics and circuitry 1	150	5
	Principles of electronic and measurement technology	150	5
	Basic concepts of radio engineering, electronics and telecommunications	120	4
	Electromagnetic fields and waves	150	5
	Electronics and circuitry 2	150	5
	Radio engineering circuits and signals	150	5
	Digital devices and microprocessor technology 2	150	5
	Digital signal processing	150	5
	Digital Communication Theory	150	5
	Pre-graduation practice	150	5
2)	Component of choice	90	3
	Basics of anti-corruption culture	90	3
	Ecology, life safety principles and SDG		

	Artificial intelligence basics		
	Radiophysics		
3	Cycle of major disciplines (MD)	2190	73
1)	University component	1500	50
	Programming of telecommunication and radio-electronic systems	150	5
	Software engineering	150	5
	Television and radio broadcasting	150	5
	Computer-aided design (CAD) system for electronic devices	150	5
	Data transfer protocols	150	5
	Fundamentals of micro- and nanoelectronics	150	5
	Embedded systems	150	5
	Electrical and radio materials science	120	4
	FPGA design	150	5
	Safety and control in radio engineering and communications	90	3
	Fundamentals of scientific research in the field of telecommunications training	90	3
2)	Component of choice	690	23
	Radio automation and telemetry	150	5
	Radio engineering devices	150	5
	Wireless communication technologies	150	5
	Fundamentals of Mobile Communication Systems	150	5
	Radio transmitting and receiving devices		
	Satellite and radio relay communication systems	150	5
	Reliability of television and radio electronic equipment	90	3
	Assessment of fault tolerance of electronic devices		
	Internet of Things	150	5
	Cloud technologies of telecommunications		
4	Additional types of education (ATE)		
1)	Elective component (military training and other types of educational activities)		
5	Final certification	240	8
1)	Writing and defending a thesis (project) or preparing and passing a comprehensive exam	240	8
	Total	7200	240

Appendix 1 Academic Calendar

Appendix 1 to the Academic Calendar

Approved by the Academic Council of the NISC "S.Seifullin KATIUS". Protocol №14 of 27.03.2025 y.

Schedule of the educational process for the 2025-2026 academic year for the educational program Energy faculty

[illegible]

Conventions

Presentati

Theoretical

Enrollment

Examination

Passing F2

Holidays

Military training

Summer

Final

Educational

Industrial

tice

Boundary control

September 1
December 16
January 1-2
August 30
October 25

Knowledge day
Independence Day of the RK
New year
New yaer
Republic Day

March 8	International Women's Day
March 21-23	Holiday " Nauryz"
May 1	Day of Unity of the Nations of Kazakhstan
May 7	Defender of the Fatherland day
May 9	Victory Day
July 6	Capital Day

registration for disciplines

RD

Considered at the meeting
of Academic Council
of the University
Protocol No. 3-26
2024



CURRICULUM
for 2025-2029 academic year
For the modular education program "Radio engineering and electronics"
by the specialty/group of educational programmes: 6059 – Communications and communication technologies
Degree: Bachelor
Form of education: Full-time (bachelor 4 years) semester
Entry year: 01-09-2025

Module code	Module name	Discipline cycle	Discipline component	Code of subject	Subject name	Academic credits	Academic study period	Control in the academic period					Number of hours					Distribution of credits per academic period																																			
								Exams	Differ. tasks	Test	Term paper	Total	Lectures	Laboratory	Practical training	Practice	Studio lessons	Practice	Independent work	Independent work	Independent work	Number of weeks in the academic period																															
																						1 course								2 course								3 course								4 course							
																						1		2		3		4		5		6		7		8		1		2		3		4		5		6		7		8	
																						1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
General modules																																																					
1	Languages	GER	CS	KRYA 1101	Kazakh (Russian) language	5	1	1				5/150				45						20	85	5.0																													
2		GER	CS	IYA 1102	Foreign language	5	1	1				5/150				45						20	85	5.0																													
3		GER	CS	IYA 1104	Foreign language	5	2	2				5/150				45						20	85																														
4		GER	CS	KRYA 1105	Kazakh (Russian) language	5	2	2				5/150				45						20	85																														
5	Socio - political knowledge	GER	CS	PS 1110	Political science and sociology	4	1	1				4/120	15			30						16	59	4.0																													
6		GER	CS	IKT 1103	Information and communication technologies	5	1	1				5/150	15			30.0						20	85	5.0																													
7		GER	CS	KP 1111	Cultural studies and psychology	4	2	2				4/120	15			30						16	59																														
8		GER	CS	IK 1120	History of Kazakhstan	5	2	2				5/150	15			30						20	85																														
9	Physical education	GER	CS	FIJ 2107	Philosophy	5	3	3				5/150	15			30						20	85																														
10		GER	UC	EPJ 2121	Economics, Law and Innovation Entrepreneurship	5	3	3				5/150	15			30						20	85																														
11		GER	CS	FK 1112	Physical education	2	1	1				2/60				15						8	37	2.0																													
12		GER	CS	FK 1113	Physical education	2	2	2				2/60				15						8	37																														
13	Mathematics and physics	GER	CS	FK 2114	Physical education	2	3	3				2/60				15						8	37																														
14		GER	CS	FK 2115	Physical education	2	4	4				2/60				15						8	37																														
15		BS	UC	M 1201	Mathematics I	5	1	1				5/150	15			30						20	85	5.0																													
16		BS	UC	Ph 1202	Physics	5	1	1				5/150	15	15.0	15							20	85	5.0																													
17		BS	UC	APYAVU	Algorithmization and High-level Languages Programming	5	2	2				3/90	15	15.0	15							12	48																														
18		BS	UC	MI 1203	Mathematics II	5	2	2				5/150	15			30						20	85																														
19		BS	UC	IM 2222	Engineering mathematics	4	3	3				4/120	15			30						16	59																														
Modules of specialty/education program																																																					
20	Electronics	BS	UC	TEC 2206	Theory of electric chains 1	5	3	3				5/150	15	15.0	15						20	85																															
21		BS	UC	ES 2226	Electronics and circuit engineering 1	5	4	4				5/150	15	15.0	15						20	85																															
22		BS	UC	CEIT 2230	Principles of electronic and measurement technology	5	4	4				5/150	15	15.0	15						20	85																															
23		BS	UC	TEC 2207	Theory of electric chains 2	5	4	4				5/150	15	15.0	15						20	85																															
24		BS	UC	EPV 2242	Electromagnetic fields and waves	5	4	4				5/150	15	15.0	15						20	85																															
25		BS	UC	CUMT 3208	Digital devices and microprocessor technology 1	5	5	5				5/150	15	15.0	15						20	85																															
26		BS	UC	ES 3232	Electronics and circuit engineering 2	5	5	5				5/150	15	15.0	15						20	85																															
27		BS	UC	CUMT 3234	Digital devices and microprocessor technology 2	5	6	6				5/150	15	15.0	15						20	85																															
28		AS	UC	SAPSEU	Computer-Assisted design (CAD) of electronic devices	5	7	7				5/150	15	15.0	15						20	85																															
29		AS	UC	PPD 4319	Data transfer protocols	5	7	7				5/150	15	30.0							20	85																															
30	Radiotechnics	BS	UC	ORET 2241	Basic concepts of radio engineering, electronics and telecommunications 1	4	3	3				4/120	15	15.0	15						16	59																															
31		BS	UC	OIT 2246	Artificial intelligence basics			3				3/90																																									
32		BS	UC	OAK 2245	Basics of anti-corruption culture			3				3/90																																									
33		BS	ES	Rad 2244	Radioelectronics	3	3	3				3/90	15	15.0							12	48																															
34		BS	UC	EOBZhC	Ecology, life safety principles and SDG			3				3/90																																									
35		BS	UC	RCS 3233	Radiotechnic circuits and signals	5	5	5				5/150	15	15.0	15						20	85																															
36		BS	UC	TCS 3227	Digital communications theory	5	6	6				5/150	15	15.0	15						20	85																															
37		BS	UC	COS 3235	Digital signal processing	5	6	6				5/150	15	15.0	15						20	85																															
38		AS	UC	ONIPNET	Fundamentals of scientific research in the field of telecommunications training	3	4	4				3/90	15		15						12	48																															
39		Radiotechnics	AS	ES	RT 3321	Radio automation and telemetry	5	5	5				5/150	15	15.0	15						20	85																														
40	AS		ES	RU 3322	Radioengineering devices	5	5	5				5/150																																									
41	AS		UC	TR 3317	Digital television and radio broadcasting	5	6	6				5/150	15	15.0	15						20	85																															
42	AS		ES	TBS 3309	Technology of wireless connection	5	6	6				5/150	15	15.0	15						20	85																															
43	AS		ES	OSMS 3323	Basics of mobile communication systems	5	6	6				5/150																																									
44	AS		UC	Ph 4320	Electrical and radio materials science	4	7	7				4/120	15	15.0	15						16	59																															
45	AS		ES	OCRU 4324	Assessment of fault tolerance of electronic devices	3	7	7				3/90	15		15						12	48																															
46	AS		ES	NTA 4310	Reliability of telecommunication equipment	3	7	7				3/90																																									
47	AS		ES	SRSS 4326	Satellite and radio relay communication systems	5	7	7				5/150	15	15.0	15						20	85																															
48	AS		ES	RRU 4312	Radio transmitting and radio receiving devices	5	7	7				5/150	15	15.0	15						20	85																															
49	Embedded systems	AS	UC	BURS 4327	Security and management in radio engineering and communications	3	8	8				3/90	15		15						12	48																															
50		AS	ES	OTT 4325	Cloud technologies of telecommunications	5	8	8				5/150	15	15.0	15						20	85																															
51		AS	UC	IV 4311	Internet of Things	5	8	8				5/150																																									
52		AS	UC	OMN 2301	Fundamentals of micro and nanoelectronics	5	4	4				5/150	15		30						20	85																															
53	Embedded systems	AS	UC	PTRS 3315	Programming of telecommunication and radio electronic systems	5	5	5				5/150	15	15.0	15						20	85																															
54		AS	UC	PI 3316	Software engineering	5	6	6				5/150	15	15.0	15						20	85																															
55		AS	UC	VS 4314	Embedded systems	5	7	7				5/150	15	15.0	15						20	85																															
56		AS	UC	PR 4314	PLD design	5	8	8				5/150	15	15.0	15						20	85																															

Additional modules beyond qualification																									
		Modules of choice																							
57	Professional practice	BS UC	UP 2239	Educational practice	2	3										60			2.0						
58		BS UC	PP 2237	Internship	5	5										150			5.0						
59		BS UC	PP 4238	Internship	3	7											90				3.0				
60		BS UC	PP 4240	Internship	4	8											120				4.0				
61		BS UC	PP 4243	Pre diploma practice	5	8										150				5.0					
Scientifically research																									
Weekly average workload at hours																									
1	General education subjects(GER)				56	10	4	0	1680	90	30	390	0	0	224	946	62	58	60	60	60	60	60	60	44
	Core subjects(GER/CS)				51	9	4	0	1530	75	30	360	0	0	204	861	21	21	12	2	0	0	0	0	0
	University component(GER/UC)				5	1	0	0	150	15	0	30	0	0	20	85	0	0	5	0	0	0	0	0	0
	Electives(GER/ES)				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Base requirements(BS)				103	18	0	0	3090	270	225	285	0	0	679	336	1404	10	8	18	20	20	15	3	8
	Core subjects(BS/CS)				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	University component(BS/UC)				100	17	0	0	3000	255	210	285	0	0	570	324	1356	10	8	15	20	20	15	3	8
	Electives(BS/ES)				3	1	0	0	90	15	15	0	0	0	12	48	0	0	3	0	0	0	0	0	0
3	Profession requirements(VRS)				73	16	0	0	2190	240	195	240	0	0	292	1223	0	0	0	8	10	15	27	13	
	Core subjects(VRS/CS)				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	University component(VRS/UC)				50	11	0	0	1500	165	135	165	0	0	200	835	0	0	0	8	5	10	19	8	
	Electives(VRS/ES)				23	5	0	0	690	75	60	75	0	0	92	388	0	0	0	0	5	5	8	5	
Total on curriculum				232		4	0	5960	600	450	915	0	0	570	852	3573	31	29	30	30	30	30	30	22	
Additional courses																									
Module of final certification (MoFC)																									
Total including FC																									
												Number of credits		Academic period		Number of hours		Number of weeks							
												8				240.0									
												240				7200.0									

Director of Department of Academic Affairs
Deputy Director of the Department of Academic Affairs
Dean of the faculty
Head of the Department

[Signature]
[Signature]
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Zhurgenov Zhakenbay Sarsenbayevich
Nurgaliyeva Almagul Shaymaratovna
Mergalimova Almagul Kaisbergenovna
Dunayev Pavel Alexandrovich

Appendix 3 Description of disciplines of the GED cycle

№	Name of discipline	Brief description of the discipline	Number of credits	Generated learning outcomes (codes)										
				LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO 10	LO 11
Cycle of general education disciplines														
Required component /University component / Component of choice														
1	Foreign language	The course program is designed for the volume of teaching - 300 hours, of which: 90 hours - classroom work and 180 hours - independent work. The course ends with a comprehensive exam. The course is designed for 3 trimesters. As a result of mastering the program, the student, depending on the level of training, reaches the level B1/) or B2 at the time of completion of the course.	10			+								
2	Kazakh (Russian) language	Language and his basic functions. Speech: kinds and forms of speech. Functionally-semantic types of speech. Functional styles of speech. General description of functional styles of speech. Common concept about scientific style of speech. Features of scientific style at lexical, morphological, syntactic level. Text as leading unit of verbal communication. segmentation of text. Theme of text. Structure and sense of text. Communicative tasks of text. A role of suggestion is in text. function of suggestion. Progression of text as increase of his volume and information content. Compression as basic type of processing of scientific text. A plan and his drafting are in a scientific sphere. Types of plans. scientific text. Composition-semantic structure of scientific text. Summarizing of scientific text. Annotating of scientific texts. Types of lemmatas. Reviewing of scientific texts. Types of reports. Criticizing of scientific text. Structure of scientific review. Review about the advanced study.	10			+								
3	Information and communication	The discipline covers the following topics: Review of computer systems. Evolution of computer systems. Architecture and components of computer systems. Data representation in computer systems. Representation of numbers and consequences. Types of	5	+					+				+	

	technologies	the software, purpose and characteristic. Basic concepts of OS. Classification of operating systems, including for mobile devices. Classification of desktop applications. Work with applications.												
4	History of Kazakhstan	The history of Kazakhstan consists of 5 thematic blocks: Ancient people and the formation of a nomadic civilization, Turkic civilization and the Great Steppe, Kazakhstan in modern times (XVIII - early XX centuries), Kazakhstan as part of the Soviet administrative-command system, Kazakhstan in the world community (1991-2022).	5					+						
5	Physical Culture	The formation of positive attitude, interest and need for physical education and sports. The improving the physical health of students on the basis of increasing the arsenal of motor abilities, professional-applied and methodical readiness. Preparation and participation in mass sports and recreational events and competitions in sports, with broad-based participation of students in the active physical culture. The Comprehensive use of physical culture and sports as a general physical training. Improving the level of physical and functional status. Preventive use of physical training for health purposes. The students gain additional, necessary knowledge on the basics of psychological, pedagogical, medical and biological control according to the method and organization of independent exercise and "lifelong" sports.	8											
6	Political Science and Sociology	Sociology in understanding the social world. Introduction to the theory of sociology. Sociological research. Social structure and stratification of society. Socialization and identity. Social change: the latest sociological debate. Political science as a science and academic discipline. The main stages of the formation and development of political science. Politics in the system of public life. Political power: the essence and mechanism of implementation. World politics and modern international relations.	4		+			+						
7	Cultural studies and psychology	Formation of students understanding of culture as the highest human value, to facilities the development of cultural needs for independent assimilation of cultural values, to reveal the essence of the main problems of modern cultural studies and the creation of a holistic view of the psyche, personality and the creative nature of the human psyche, the ability to work in a team. Training in the skills of socio-psychological analysis and resolution of specific professional situations.	4		+			+						

8	Philosophy	The emergence and development of philosophy. Basics of philosophical understanding of the world. Consciousness, soul and language. Being. Ontology and metaphysics. Human philosophy and value world. «Máńgilik El» and «Rýhanı jańgyrý» - a new philosophy in Kazakhsta.	5		+			+						
9	Economics, law and innovative entrepreneurship	The discipline is aimed at developing a systematic understanding of the key aspects of entrepreneurship, taking into account economic, legal and financial factors. The course covers modern approaches to business organization and management, legal foundations of entrepreneurship, as well as financial instruments necessary for sustainable development of enterprises.	5		+									

Appendix 4 Description of the disciplines of the BD cycle

№	Name of discipline	Brief description of the discipline	Number of credits	Generated learning outcomes (codes)										
				LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO 10	LO 11
Cycle of basic disciplines														
University component / Component of choice														
1	Mathematics I	Linear algebra, Analytical geometry on the plane, Vector algebra, Analytical geometry in space, Theory of limits.	5					+						
2	Algorithmization and High-level Languages Programming	Introduction to programming languages. The life cycle of the program. Formulation and specification of the program. Basic concepts of algorithmization. Programming in a high-level language. Representation of the main control structures of programming. Methods of designing programs. Program approvals. Methods of program verification. Modular program. Procedures and functions. Arrays. Features of programming in integrated environments. Debugging and testing programs.	3										+	
3	Physics	The discipline studies the basic physical phenomena, fundamental laws and concepts, as well as methods of physical research. Considers techniques and methods for solving typical problems from various fields of physics, introduces modern scientific equipment, forms the skills of conducting an experiment, the ability to highlight specific physical content in applied problems of a future specialty.	5					+			+			
4	Mathematics II	Differential calculus of one variable, Integral calculus of one variable, Definite integral, Differential calculus of functions of several variables.	5					+						
5	Educational practice	Reinforcement of knowledge in the disciplines of General professional and special training, formation of skills of using the scientific and methodological apparatus of these disciplines, obtained during the theoretical learning, the acquisition of	2										+	

		practical vocational skills needed for independent work in major areas of activity of bachelor by the profile of the provisioning.													
6	Engineering mathematics	General information of mathematical description and modeling of various real phenomena and processes. combined disciplines combining elements of physics, mathematics, computer methods of calculation are focused on the application of established methods for the design and analysis of engineering solutions in the field of mechanical engineering.	4					+							
7	Theory of electric chains 1	Methods for calculating of DC electrical circuits. Balance of power. Computersimulation of electrical circuits. Balance of power in circuits with harmonic effects. Resonance in electrical circuits. Frequency characteristics of the parallel circuit. Bandwidth. Methods for calculating of inductively coupled circuits. Decomposition on Fourier series. Calculation of circuits with periodic non-sinusoidal effects. Four-poles. Electric filters.	5						+						
8	Basic concepts of radio engineering, electronics and telecommunications	Fundamentals of radio engineering, electronics and telecommunications. Purpose of functional units of radio engineering systems, OSI network model, purpose, operating conditions. Data transmission via Internet and telephone network, ATS and its structural structure, digital network with service integration, intelligent network, NGN main trends in the development of telecommunication networks systems.	4						+		+				
9	Electromagnetic fields and waves	The basic laws of electrodynamics. Wave equation for the electromagnetic field. Plane electromagnetic waves in homogeneous and isotropic media. Electromagnetic plane waves in frequency dispersion media. Wave phenomena at the interface of the media. Guided electromagnetic waves. Rectangular metal waveguides. Round metal waveguides. Cavity resonators.	5					+			+				
10	Theory of electric chains 2	Transients in electrical circuits, switching laws and initial conditions; transient conditions, transients in RL-RC - and RLC circuits of constant and harmonic voltage; enforced and free mode.	5						+						

		The classic method of calculating transients. Operator method for calculating transients. Laplace transforms. Calculation of transients at arbitrary input effects using the Duhamel integral. Calculation of transient processes with impulse effects.												
11	Principles of electronic and measurement technology	Electrical conductivity of semiconductors. Electron-hole transition. Semiconductor devices. Basics of metrology. Measurement as an object of metrology. Types and methods of measurement. Basic measurement tools. Classification of measurement errors. Measuring transducers. Analog measuring instruments. Digital devices. Microprocessor devices. Fundamentals of standardization. Goals, significance and objectives of standardization. International standardization. Basics of certification. Varieties of certification systems. State certification system of the Republic of Kazakhstan.	5				+					+		
12	Electronics and circuit engineering 1	The structure and principle of operation of semiconductor devices. Varieties and structure of power sources. Parametric and compensation regulators of voltage. Dependent and autonomous voltage inverters. Optoelectronic devices. Circuitry amplifying devices. Feedback amplifiers. The purpose of feedback and how to organize them.	5	+						+		+		
13	Production practice	Professional practice is a compulsory section of the educational program and is a type of educational activity focused on the professional and practical training of students. The purpose of professional practice is the systematization, synthesis and deepening of theoretical knowledge and skills acquired by students during the development of the educational program, the formation of professional skills and professional experience of the bachelor of students.	12	+					+	+		+		
14	Digital devices and microprocessor technology 1	Introduction to Digital Electronics (DE). Number Systems in DE. Basic logic elements. Boolean Algebra. Encryptions and decoders. Multiplexers and demultiplexers. RS, D, JK and T triggers. Sequential and countdown action of counters. Shift regis-	5					+				+		

		ters: sequential, parallel and universal. Arithmetic devices. Summators and subtractors. Binary subtraction and summation. Binary multiplication, binary division.												
15	Electronics and circuit engineering 2	Impulse devices. Algebra of logic. Logical messages, logical operations, the simplest logical elements. Basic logic elements. Types of logic chips. The main parameters of the IC. Combinational logic circuits. CLC varieties. Sequence integral CLC. Pulse distributors. Counters with an arbitrary count factor. Pulse counters. Digital to Analog Converters (D / A). Analog-to-Digital Converters (ADC).	5	+						+		+		
16	Radiotechnic circuits and signals	Classification of signals. Dynamic representation of signals. Geometric representation of signals. Generalized spectral representation of signals. Deterministic signals. Kotelnikov theorem. Spectrum of a discrete signal. Modulated signals. Classification types of modulation. Random signals. Elements of probability theory. Random processes and their probabilistic characteristics. The energy spectrum of a random process. Wiener-Khinchin theorem, Fundamentals of the theory of linear parametric chains. Discrete signal processing and digital filters. Optimum linear signal filtering.	5								+			+
17	Digital devices and microprocessor technology 2	Basic definitions in microprocessor systems. Classification MPS. Principles of von Neumann. Architecture of MPS. Memory in the MPS. Classification of MPS commands. The composition of commands MPS. Structure of MPS. MPS circuit outputs and the appointment of the main elements. MPS programming. Language ASSEMBLER. Basic concepts. Interruptions in the MPS and work with them. Stack in the MPS and work with it. Program model of MPS. Interfaces inputs outputs of MPS. The main stages of documenting MPS programs.	5					+				+		
18	Digital signal processing	Discrete signals. Discrete systems. Basics of digital filtering. Filtering random signals. Computational process and computational algorithms. Digital frequency filters. Linear phase digital	5					+				+		+

		filters. Deconvolution of signals. Deconvolution filters. Wavelet transform. Wavelet function. Kuranen-Loeve discrete transformation. Digital filter, optimal by the criterion of maximum signal-to-noise ratio. Special discrete random processes. Special discrete random processes.												
19	Digital communications theory	Classification of signals. Dynamic representation of signals. Geometric representation of signals. Generalized spectral representation of signals. Deterministic signals. Kotelnikov theorem. Spectrum of a discrete signal. Modulated signals. Classification types of modulation. Random signals. Elements of probability theory. Random processes and their probabilistic characteristics. The energy spectrum of a random process. Wiener-Khinchin theorem, Fundamentals of the theory of linear parametric chains. Discrete signal processing and digital filters. Optimum linear signal filtering.	5							+				+
20	Pre-graduate practice	Application of knowledge gained in the development of the educational program in practice and preparation for writing a thesis.	5				+			+	+	+	+	+
21	Basics of anti-corruption culture	The course forms a system of knowledge on combating corruption, and develops on this basis a civil position in relation to this phenomenon. The discipline studies the fundamentals of legislation; normative legal acts, moral and legal norms.	3		+									
22	Ecology, life safety principles and SDG	The discipline studies the interrelation of environmental science with other sciences, the patterns of interaction between organisms and their habitat, the laws of development and existence of biogeocenoses as complexes of interacting living and inanimate components in various parts of the biosphere, the goals of sustainable development (namely, global problems of humanity and ways to solve them), issues of preserving human health and life in the technosphere, protection from hazards of man-made and natural origin and the creation of comfortable living conditions.	3		+		+							

23	Artificial intelligence basics	AI principles, history, ethics, text processing, computer vision, decision-making systems, logic, planning, and utilizing platforms like GPT, IBM Watson, and Microsoft Azure AI for data analysis and process automation.	3		+									
24	Radiophysics	Radiophysics. Correctly express physical ideas, apply the laws of physics to analyze and solve specific physical problems of radiophysics; use basic physical instruments, take measurements, process the results obtained and analyze them; use scientific, educational, methodological and reference literature. Skills of scientific analysis and forecasting of various phenomena and processes.	3					+			+			

Appendix 5. Description of disciplines of the MD cycle

№	Name of discipline	Brief description of the discipline	Number of credits	Generated learning outcomes (codes)										
				LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO 10	LO 11
Cycle of major disciplines														
University component / Component of choice														
1	Fundamentals of scientific research in the field of telecommunications training	Definition of the object and subject of research, formulation of goals and objectives, selection of research methods and stages, conducting research, analyzing results and drawing conclusions. Statistical processing of experimental data and elements of variance analysis.	3		+									
2	Fundamentals of micro and nanoelectronics	Tasks and principles of microelectronics and nanoelectronics. Integrated circuits (IC). The principle of integration. Fundamentals of manufacturing IC. Features of the structure and topology of transistors in the integrated design. Elements of bipolar and TIR IC. Different types of ICs. Quantum-size effects in nanoelectronics. Fabrication and research methods of structures with quantum dots Devices based on quantum effects.	5									+	+	
3	Programming of telecommunication and radio electronic systems	Python programming language. Comparison Operators in Python. Advantages and disadvantages of the language. Data types. Equivalent to null None. Check for no. Basic modules. Operations on files and directories. High-level functions for creating and reading archived and compressed files. Request the size of the final output. Unittest module. Command line interface. Test detection. The organization of the test code. Checks for success. Subprocess module Fraction Modules, cmath, glob, functools, os.path. Python for the Web.	5									+	+	

4	Software engineering	Models and life cycle profiles. Processes of software life cycle of microprocessor and embedded systems. Project management software automation systems. The main processes of software engineering. General issues of software engineering processes. Methods and tools of software engineering. Formal and applied models of software engineering. Use of methodology in field of theory of system and analysis of systems in software engineering.	5									+	+	
5	Television and radio broadcasting	Converting an optical image into an electrical signal. Block scheme of the television system. Principles of building converters. Sensors of television signals and their characteristics. Color television systems. Colorimetric determination of color. Digital representation of image signals. Compression of digital television signals. MPEG-1,2,4 and MPEG-7 video compression: Digital modulation of video signals. Digital television broadcasting DVB: Broadcasting systems. Broadcasting in Long Wave, Middle Wave and HF bands. Digital broadcasting.	5								+			+
6	Computer-Assisted design (CAD) of electronic devices	Methodology for designing integrated circuits. Design principles. Design methods. Stages of design of electronic devices. Development specification. Logical design. Circuit design. Topological design. Component design. CAD architecture of electronic devices. Software design. Design routes ULSI. Automation design semi-custom VLSI. Automation design custom ULSI. CADENCE design tools. Design Tools Company SYNOPSYS. Design tools of the company MENTOR GRAPHICS.	5	+								+		
7	Data transfer protocols	The concept of the protocol and the protocol stack. Presentation of protocols by function. Organizations (IETF, IEEE, ISO, ITU-T) developing and regulating protocols. Basic Reference Model of Open Systems Interconnection - ISO / OSI. Levels, tasks and related protocols. Comparison of the OSI model and other models. The TCP / IP, IPX / SPX protocol family. Stacks of protocols NetBIOS / SMB, NovellNetWare, DECnet. Protocols X.25, FrameRelay, MPLS, FTP. Telephony protocols V5, VoIP.	5								+	+		

8	Electrical and radio materials science	General information about the materials of electronic engineering. Types of communication connections. Elements of the band theory of solids. Conductive materials. Superconducting metals and alloys. Alloys for thermocouples. Refractory metals. Non-metallic conductive materials. Semiconductor materials. Own and impurity semiconductors. Electrophysical phenomena in semiconductors. Silicon. Solid solutions based on semiconductors. Dielectrics. Electrets. Liquid crystals. Materials for solid-state lasers. Magnetic materials.	4										+	
9	Embedded systems	Classification of microprocessors and microcontrollers. Overview of modern microcontrollers of various companies. The general block scheme of a micro-computer. Presentation of the main devices of microcomputers: microprocessor, main memory, interfaces, external devices, bus. Physical organization of memory: ROM and RAM. CISC processor. RISC processor. General purpose registers. Registers of external devices. Conveyor teams. Sub-level sensors and actuators: the appointment of technical means. Contact sensors. The main type so factuators.	5				+			+		+		+
10	PLD design	Classification of digital ICs. Comparison of various approaches to the design of digital devices: using integrated circuits of small integration, fully custom circuits, basic matrix crystals, integrated circuits with programmable structure and microcontrollers. Creating a project in the environment MAX + PLUSII. Basic design procedures for CAD MAX + PLUSII. Simulation program. FPGA Programmer. Using the graphical editor in max.plus + plusii. Designing FPGA in the basis of primitives.	5	+								+	+	
11	Security and management in radio engineering and commu-	The concept and principles of TMN (Telecommunication Management Network - Network management system of telecommunication operators). Means and technologies for ensuring information security of telecommunications networks and signals of radio engineering systems. Study of information security management processes of protected objects.	3		+		+							

	nications													
12	Radio automation and telemetry	Differential equations. transient and transfer functions. Frequency, logarithmic frequency characteristics of RA. Typical system links. Oscillating, integrating links. Investigation of the stability of linear automatic control systems. Mikhailov stability criterion. Convert message to signal and separation of elements. Methods of election and group selection. The main nodes of the device TU-TC. Amplification and translation points. Encryption, decoder node.	5	+					+		+			
13	Radioengineering devices	Functional and structural diagrams of radio engineering devices. Generators with external excitation. Digital modulation methods in modern radio communication and radio access devices. The problems and ways of its resolution in terms of building a highly efficient and high-quality power amplification of multi-frequency signals OFDM type. General information about radio engineering devices. Schemes of their construction. The main components of radio engineering devices.	5	+					+					
14	Technology of wireless connection	Classification of wireless communications. Spectrum conversion methods using carrier frequency. Amplitude, frequency, two-phase phase shift keying. Coherent and incoherent detection. Multiposition phase and quadrature amplitude modulation. Multiple access. Spectrum spreading methods. Features of the transmission channel in wireless systems. Models of signal power loss calculation. The concept, components, principles and systems of the cellular network. Trunking systems. Cordless telephony. Standards IEEE 805.15. X., IEEE 802.15.4.; 802.11. LPWAN technology.	5								+			+
15	Basics of mobile communication systems	Overview and classification of modern mobile radio communication systems. Organizational system of mobile radio communication systems. the composition and structural elements of the cellular communication system. The system of base stations. Features of radio wave propagation in mobile communication systems. Functioning of cellular mobile radio communication systems. Radio planning of cellular mobile radio communication systems.	5								+			+

16	Radiotransmitting and radioreceiving devices	Functional scheme of radio transmitting devices. External excitation generator. Digital modulation techniques in modern radio communications and radio access devices. The problem and the ways of its solution in terms of building a highly efficient and high-quality gain of multi-frequency power of OFDM signals. The main technical indicators and the structure of radio receivers. Frequency converters. General information about radio receivers. Schemes of construction. The main nodes of radio receivers.	5	+					+		+			
17	Satellite and radio relay communication systems	Features of propagation of radio waves in near-Earth space. Primary telecommunication signals and their characteristics. Satellite communication systems (SCS); basic principles of construction; orbit parameters; types of orbits. The main characteristics of the structure of space stations. Ground segment. Block diagram of the earth station. VSAT systems. Energy calculation of satellite communication line. Electromagnetic compatibility. Overview of existing and prospective SCS. General principles of building RRL. Principles of construction of radio relay equipment. RRL design.	5			+					+			+
18	Reliability of telecommunication electronic equipment	The problem of evaluating the reliability of electronic equipment. Basic concepts of the theory of reliability of electronic equipment. The reliability of the element of technical systems REA. Mathematical apparatus of the theory of reliability REA. The concepts of failure and recovery elements of electronic equipment. Distribution functions of trouble-free operation of electronic equipment. Determination of the reliability of the technical system of electronic equipment for the reliability of its elements. Hardware redundancy. Factors determining the reliability of electronic equipment. Reliability of the system with the restoration of electronic equipment.	3				+						+	
19	Assessment of fault tolerance of electronic	The problem of assessing the fault tolerance of electronic devices. The basic concepts of probability theory applied to the assessment of fault tolerance of electronic devices. Fault tolerance of an element of technical systems. Types of failures. Bounce distribution functions. Concepts of recovery and failure of elements of electronic devices. Statistical methods for assessing the fault tolerance of electronic devices.	3				+						+	

	devices	Mathematical model of fault tolerance of electronic devices. Factors affecting the fault tolerance of electronic devices.												
20	Internet of Things	Introduction to the Internet of Things. IOT application scenarios. Data transfer technologies for IOT. Hardware part Standard interfaces. Data processing, cloud storage. Practical work with devices.	5								+		+	+
21	Cloud technologies telecommunications	Intelligent information systems, IoT systems. Network infrastructure of cloud technologies. Cloud standards. Cloud production. Application cloud services. Cloud computing. Data centers. Storage systems. 5G technology. Data virtualization. Information security. Sealing and multiple access. Extended spectrum methods. Source encoding. Channels with fading.	5								+		+	+

