MINISTRY OF AGRICULTURE OF THE REPUBLIC OF KAZAKHSTAN
"NJSC "S. SEIFULLIN KAZAKH AGROTECHNICAL UNIVERSITY"

Approve
NJSC "Saken Seifullin Kazakh
Deputy Chairman of the Management
Board Academic Activity-Rector
_____ A.M Abdyrov.
«_____» _____ 2021.

CATALOG OF ELECTIVE COURSES

For students in groups of educational programs

Telecommunications networks and systems

Nur-Sultan, 2021

MINISTRY OF AGRICULTURE OF THE REPUBLIC OF KAZAKHSTAN
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Brief description of elective disciplines of the educational program

Biotechnology in fish aquaculture

1	Name of course	Ecology and life safety
2	Code of course	EOBZh 1118
3	Cycle of course	GER ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	1
8	Prerequisites	Biology, Chemistry in the scope of the school curriculum
9	Postrequisites	TCB of the specialty in accordance with the
10	Course summary	The general concept of ecology and the Basics of Life safety as a theoretical basis for the protection of society and nature. The relationship of organisms to the environment and habitat. Vernadsky's Biosphere Concept. Definition of the modern noosphere. Environmental problems of our time. Fundamentals of life safety. The concept of the technosphere. Principles of ensuring the safety of human interaction with the environment. Possible, real and existing threats of natural and man-made origin.
11	Learning outcomes	The study of the laws of existence. Study of the patterns of formation and functioning of biological systems at all levels of interaction from the organism to the biosphere and the environment. Analysis of the influence of environmental factors on the vital activity of living organisms and the environment; Master the methods of analyzing environmental processes, determine specific goals and priorities for the protection of the environment and society Application of methods for determining and quantifying the main pollutants of pollutants into the environment for the analysis of processes occurring in the constituent parts of the biosphere and the development of environmental protection measures. Learn how to correctly formulate and justify your point of view on current issues of life safety. Improving the rules and methods of protection against emergencies; Mastering the main ways of individual and collective protection of life and health in emergency situations of peace and war. Identification of possible consequences and causes of an environmental emergency Use of the acquired knowledge about the model of interaction between living organisms and the environment for environmental protection and life safety.

1	Name of course	Fundamentals of economics and law
2	Code of course	OEP 2119
3	Cycle of course	GER ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	2
8	Prerequisites	Philosophy, history of Kazakhstan, mathematics
9	Postrequisites	Business law
10	Course summary	Discipline Fundamentals of Economics and Law. Economic systems and the foundations of social production. Types of public economy, the origin of money. The mechanism of functioning of the market system: demand, supply, price, and competition. Production, profit and loss of the company, the market of factors of production. National economy: content, structure, comparison of results. Economic growth and market economy instability: inflation and unemployment. State regulation and economic security of the national economy. The main branches of Kazakhstan law. Constitutional law. Administrative law. Family law. Labor law. Criminal law.
11	Learning outcomes	knowledge of the laws of economic development and law; knowledge of the basic concepts of the evolution of economic K6 created over a long time; be able to systematically explain the conditions and meaning of the existence of economic phenomena and processes; knowledge of the principles of the mechanism of functioning of the market economy; have the skills to analyze the state and trends of socio-economic development of the national and global economy; formation of interdisciplinary skills in solving economic and legal problems; instilling skills for lifelong learning in economics and law; proficiency in the implementation of tasks both physical and legal

1	Name of course	Cable systems in Contact
2	Code of course	KSS 3208
3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	3
8	Prerequisites	Electromagnetic fields and waves.Theory of electrical circuits -1. theory of electrical circuits. Telecommunications industry.Telecommunications scheme.
9	Postrequisites	Transporttechnology of communication lines.Telecommunications operation and design of systems and networks in operation.Reliability of TV and radio electronic equipment.
10	Course summary	Classification of guide systems in telecommunications, frequency range and design features. Electrodynamics of guide systems. Primary and secondary distribution parameters. Theory of optical communication systems. Optical fibers, design features. Parameters of the optical fiber and cable. Electro-magnetic effects and corrosion on telecommunications cables. Design, installation and operation of SCS in telecommunications.
11	Learning outcomes	Это обязtypes of guide systems and their main properties; theory and electrodynamics of guide systems in telecommunications; electromagnetic influences in guide systems and protection measures against them; special questions about guide systems in telecommunications. know and understand: guiding systems in telecommunications and their place in telecommunications; features of guiding systems from each other; processes in guiding systems; methods of protection against electromagnetic influences. be able to: work in accordance with the new requirements in telecommunications for the installation and construction, design and operation (operation) of guide systems; select and update the distribution system of the cable trunk, the type of cable (communication lines), the main technological equipment, taking into account the latest achievements in science and technology; design the routes of the communication line (guide system) in the optimal version when developing a group of peripheral and intermediate devices; know the calculation of the parameters of the cable and other guide systems using literature and reference books and be able to choose the correct mode of operation; have an idea of the mutual and dangerous effects on the guide systems and know the methods of protection against them; be able to update the throughput of distribution systems working with certain guide systems in telecommunications. have the skills of: installation of various cables, operation (operation) of communication cables and equipment; design of the cable network in various telecommunications departments.ательный вопрос.

1	Name of course	Wireless communication technologies

2	Code of course	TBS 3310
3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	2, 3
8	Prerequisites	Engineering mathematics, fundamentals of telecommunications, electromagnetic fields and waves, antenna-feeder devices and radio waves, digital signal processing
9	Postrequisites	Design and operation of telecommunications networks, communication networks for IOT
10	Course summary	Classification of wireless communications. Amplitude, frequency, and two-position phase manipulation. Coherent and incoherent detection. Multi-position phase and quadratic amplitude modulation. Public access. Methods of spectrum expansion. Features of the transmission channel in wireless systems. Models for calculating signal power loss. Cellular network concept, components, principles, and systems. Trunking systems. Telephony without a cord. IEEE 805.15.X., IEEE 802.15.4:, 802.11. LP VAN technology
11	Learning outcomes	Have an understanding of the principles of operation, creation and application of wireless networks and systems based on them. Know and understand modulation methods; access methods in wireless networks; spectrum expansion technologies; protocols of the physical and channel levels of the radio interface of wireless communication networks; methods of application and construction of wireless communication technologies, architecture. Carrying out the necessary calculations in the development of a wireless communication system; carrying out frequency planning of a mobile radio network; calculating the required equipment of a wireless system; selecting the equipment parameters necessary for the organization of a wireless network; conducting a program analysis of the characteristics of wireless technologies; applying theoretical knowledge in practice. Methods of modeling, optimization and calculation of wireless network systems; methods of analysis and search for implementation options for mobile radio communication systems. Practical skills of working with specific devices on computer modeling of signals, functional devices and wireless communication systems, organization of radio access.

1	Name of course	Programming of telecommunications and radio-electronic systems
2	Code of course	PTRS 3204
3	Cycle of course	BS ES
4	Amount of credits	5

5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	3
8	Prerequisites	Algorithmization and programming in high-level languages, Fundamentals of Telecommunications, Mathematics, Digital Devices and Microprocessor technology 1.
9	Postrequisites	Design and operation of telecommunications networks, packet and hybrid networks
10	Course summary	The Python programming language. Comparison operators in Python. Advantages and disadvantages of Python. GUI (graphical user interface). Python data types. The equivalent of null in Python: None. Check None. Basic modules in Python. Operations with files and directories. High-level functions for creating and reading archived and compressed files. Request for the size of the terminal output. Unittest module: check the programs. Command-line interface. Defining tests. Organization of the test code. Check for success. The Subprocess module. The Fractions module. The Cmath module. The Glob module. The Functiontools module. The OS.path. Python module for the Web.
11	Learning outcomes	Algorithmization and programming in high-level languages, Fundamentals of Telecommunications, Mathematics, Digital Devices and Microprocessor technology 1.

1	Name of course	English for special purposes
2	Code of course	AYaDSC 2213
3	Cycle of course	BS ES
4	Amount of credits	6
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	2
8	Prerequisites	Bachelor's degree level B1-B2 " English»
9	Postrequisites	Subjects in the specialty in a foreign language

10	Course summary	The course of the program is designed for 180 hours, of which: 54 hours for classroom work and 108 hours for independent work. The course ends with a comprehensive exam. The course is designed for 1 semester. Active vocabulary-1600-2000 words, passive vocabulary-400-500 words. Formation of reading skills with a full understanding of the text of level B1 and thematic and professional text of level B2. Formation of skills of writing essays, presentation using special professional terms, 250-500 words in the specialty. Formation of the perception skill by listening to an authentic message containing professional information, lasting 1.5-4.5 minutes. Formation of the ability to correctly convey the content of the text, to enter into a dialogue or polylogue, a discussion using language units, a special lexical and academic dictionary
11	Learning outcomes	At the end of the educational course, as a result of mastering the program, the student reaches the level B1-(IELTS 4.0-5.0) or B2 - (IELTS5. 5-6. 0), depending on the level of training and the formation of skills for solving professional, interpersonal and intercultural relationships.

1	Name of course	Electromagnetic fields and waves
2	Code of course	EPV 2214
3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	2
8	Prerequisites	Physics, Mathematics
9	Postrequisites	Satellite radio relay and communication systems
10	Course summary	The basic law of electromagnetic waves. The wave equation for the field of Electromagnetik. Plane electromagnetic waves for homogeneous and isotropic media. A plane electromagnetic wave for a frequency-dispersion medium. Wave phenomenon at the interface of media. Guiding electromagnetic waves. Aratkyshtar metal rectangular wave shape. Round metal waveguides. Volumetric resonators.

11	Learning outcomes	Knowledge of the basics of electromagnetic processes occurring in various environments on linear PLA devices and ways of distribution of electromagnetic energy; Be able to analyze the results of physical experiments in the field of electromagnetic waves, apply theoretical knowledge to the state of radio communication systems and solve special physical problems; Mastering the application of the law of electromagnetic wave propagation in various ranges in the design and operation of radio communication systems and methods for solving specific problems in the field of the basis of electromagnetic wave propagation

1	Name of course	Television and radio broadcasting
2	Code of course	TR3210
3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	3
8	Prerequisites	Digital devices and microprocessor technology 1. antenna-feeder devices and radio-wave broadcasting
9	Postrequisites	Network and hybrid switching networks, Transport network technologies, satellite radio relay and communication systems, radio transmitting and receiving devices, digital signal processing
10	Course summary	Elemental analysis and synthesis of optical images. Converting an optical image into an electrical signal.Principles of converter construction. TV signal sensors and their characteristics. Color television systems.Digital television systems. Compression of digital television signals. MPEG-1,2,4 and MPEG-7 video compression. Digital video modulation. DVB digital TV broadcasting distribution.
11	Learning outcomes	Know: the principles of digital television and radio broadcasting, the features of their functioning, standards, frequency ranges and wavelengths; the basics of digital television formation, transmission of audio signals and their various communication channels; the composition of television and radio-centric means. Perform: calculation of the required frequency band, the amount of equipment for television and radio systems, analysis of system reliability, planning and design of digital television and radio communications. Possess: methods of operation and configuration of television and radio systems, skills of planning, designing, functioning of these systems and determining the performance and quality of systems.

1	Name of course	Digital devices and microprocessor technology 2.
2	Code of course	CUMT 3206
3	Cycle of course	BS ES
4	Amount of credits	8
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	3
8	Prerequisites	Mathematics 1, 2, Theory of electrical circuits 1, Digital devices and microprocessor technology 1, Electronics and Circuit Engineering 1,2.
9	Postrequisites	Television and radio broadcasting. Software engineering. Combined systems. Digital signal processing. Registration in BLYTH. Internet of Things.
10	Course summary	Basic definitions of microprocessor systems. Classification of MJ. MJ memory. Classification of MJ teams. The composition of the MJ and KPT team. Construction of KPT. Output diagrams of the CBT and the purpose of the main elements. MJ programming. Assembly language. MJ breaks and working with them. MJ stack and working with them. The software model of the microprocessor. MJ input and output interfaces
11	Learning outcomes	Must know: the principles of operation of the microprocessor and microcontrollers, historical development, the main nodes inside the microprocessor, circuitry Be able to: select the element base and circuit solutions for the development of digital devices of various degrees of complexity; design and develop various functional units of digital and microprocessor technology; improve their algorithms in digital and microprocessor devices. Possess: practical work with documentation and reference information on digital devices and microchips; design of specific devices in accordance with the terms of reference; organization of initial setup work in a low programming language (assembler).

1	Name of course	Electronics and circuitry 2
2	Code of course	ES 3207
3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	3
8	Prerequisites	Mathematics 1. Mathematics 2. Physics. Theory of electrical circuits 1
9	Postrequisites	Digital devices and microprocessor technology 2.
10	Course summary	Pulse devices.Logic algebra. Logical messages, logical operations, elementary logical elements . Basic logic elements. Types of logic chips. The main parameters of the IMS. Combinational logic circuits. Stages of creating a KLS. Types of KLS.Combined integrated circuits. Chain integral KLS. Pulse transmitters. Counters with a random count coefficient. CAT. AZT.
11	Learning outcomes	Know: electronic pulse devices; features of Boolean algebra; logical operations and their purpose; types and schematic implementation of elementary logic elements; basic logic elements; basic types of logic and their schematic implementation; combinational logic circuits(KLS); integrated KLS; serial integrated electronic devices; digital pulse counters; digital-analog and analog-to-digital converters; microprocessors; microprocessor systems; microcontrollers. Possess: current information about the prospects and problems of the development of electronic devices of circuitry; methods of analysis and calculation of integrated electronic devices.; Be able to: choose the necessary integrated electronic device; work in various types of modern logic; navigate in the design of circuit design options of integrated microcircuits; set goals and objectives in the field of modern microcircuits

1	Name of course	Antenna-feeder devices and radio wave propagation
2	Code of course	AFURR 3200
3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	3
8	Prerequisites	Mathematics I, II. Physics. Theory of electrical circuits 1. Fundamentals of electronic and measuring technology. Electromagnetic fields and waves
9	Postrequisites	Television and radio broadcasting, wireless communication technologies, programming in TV and radio communication devices and systems. Satellite radio relay and communication systems
10	Course summary	Propagation of radio waves in free space. Calculation of Radio and TV broadcast coverage areas. Propagation of radio waves in urban environments and inside buildings. Gas station-propagation of radio waves on the earth's path. Calculation of the field of a short-wave radio path of Far tropospheric propagation. Fundamentals of antenna theory. Vibratory ,directional, logoperiodic, parabolic antennas.
11	Learning outcomes	Know and understand: electromagnetic phenomena that occur when using antenna-feeder devices (AFU) from the point of view of the theory of the electromagnetic field. Be able to: calculate the main parameters and characteristics of AFC blocks and nodes. Possess: methods of ROS modeling, practical skills in designing simple ROS.

1	Name of course	Digital signal processing
2	Code of course	COS 3200
3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	3
8	Prerequisites	Mathematics I, II, theory of electrical circuits 2, theory of electrical connections.
9	Postrequisites	Wireless communication technologies
10	Course summary	Discrete signals. Discrete systems. Fundamentals of digital filtering. Signal filtering. Computational process and computational algorithm. Digital frequency filter. Linear-phase digital filter. Deconvolution of signals. Effective deconvolution filters. Modification of the wavelet. The wavelet function. Discrete Karunen-Loew transform. Digital filter, the ratio of the maximum to the noise signal on a rational basis. Special discrete random processes. Autoregressive moving average process.
11	Learning outcomes	Know: as a result of studying the discipline, students should know: the main types and characteristics of signals; fundamentals of digital signal processing; mathematical analysis of signals; principles of digital filters. Be able to: calculate the characteristics of analog and digital converters; have an understanding of the basic mathematical methods of processing; measurement of electrical values of radio engineering systems; working with technical literature. Master: the basic techniques of applying the theories of analysis, calculation and accumulation of signals in special disciplines and for the successful solution of engineering problems of the future profession. Development of practical skills: processing, distribution and storage of information, signal analysis, rules of operation of digital filters.

1	Name of course	Data transfer protocols
2	Code of course	PPD 4308

3	Cycle of course	BS ES
4	Amount of credits	3
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	4
8	Prerequisites	The concept of a protocol stack and a protocol. Provision of protocols for their functional purpose.Organizations that develop and regulate protocols (IETF, IEEE, ISO, ITU-T). The basic reference model for open systems interaction is ISO / OSI. Levels, tasks performed, and related protocols. Comparison of the OSI model and other models. Collection of TCP/IP, IPX/SPX protocols. NetBIOS/SMB protocol stacks, NovellNetWare, DECnet. X. 25, FrameRelay, MPLS, FTP protocols. V5, VoIP telephony protocols.
9	Postrequisites	OSI knowledge of the model and other protocol stacks. Be aware of the differences in data transfer protocols. Be able to distinguish between protocols by their functional purpose and their compliance with the levels of interaction models. Master the techniques of verifying the correctness of the protocols.
10	Course summary	he concept of a protocol stack and a protocol. Provision of protocols for their functional purpose.Organizations that develop and regulate protocols (IETF, IEEE, ISO, ITU-T). The basic reference model for open systems interaction is ISO / OSI. Levels, tasks performed, and related protocols. Comparison of the OSI model and other models. Collection of TCP/IP, IPX/SPX protocols. NetBIOS/SMB protocol stacks, NovellNetWare, DECnet. X. 25, FrameRelay, MPLS, FTP protocols. V5, VoIP telephony protocols.
11	Learning outcomes	OSI knowledge of the model and other protocol stacks. Be aware of the differences in data transfer protocols. Be able to distinguish between protocols by their functional purpose and their compliance with the levels of interaction models. Master the techniques of verifying the correctness of the protocols.

1	Name of course	Internet of Things
2	Code of course	IV 3312
3	Cycle of course	AS ES
4	Amount of credits	3
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications

7	Year	3
8	Prerequisites	Math II. Information and communication technologies. Algorithmization and programming in high-level languages. Electronics and circuitry 1. Digital devices and microprocessor technology 1. Theory of digital communication. Wireless communication technologies.
9	Postrequisites	LPWAN for the Internet of Things
10	Course summary	Introduction to the Internet of Things. IoT usage scenarios. Data transfer technologies for IoT. IoT hardware. Standard interfaces. Data processing, cloud storage. Practical work with devices..
11	Learning outcomes	Having an understanding of Internet subjects (IoT). Knowledge of the organization and functioning of the" Internet of things". Understanding the concept of IoT and M2M. Be able to work with microcontrollers and basic debugging boards, distinguish between existing IoT technologies and apply them in specific scenarios. Have skills in designing Internet of Things systems.

1	Name of course	Software Engineering
2	Code of course	PI3302
3	Cycle of course	AS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	3
8	Prerequisites	Information and communication technologies, algorithmization and programming in high-level languages, programming on TV and radio communication devices and systems.
9	Postrequisites	Combined systems, Internet of Things

10	Course summary	Life cycle models and profiles. Life cycle processes of software tools for microprocessor-based and plug-in systems. Project management of automation system software tools. Basic software engineering processes. General issues of performing software engineering processes. Methods and tools of software engineering. Application of the methodology of the theory of computational processes and the theory of program schemes in software engineering
11	Learning outcomes	Knowledge of computer science and computer technology, modern trends in the development of computer technologies; the basics of building information systems and using new information technologies for information processing; software life cycle; object-oriented programming; theory and methods of classification; elements of complexity theory. Be able to: apply methods and tools for creating and processing technical documentation; current trends in the development of computer science and computer technology, computer technologies; fundamentals of creating information systems and using new information technologies for information processing; software life cycle; object-oriented programming; theory and methods of classification; application of elements of complexity theory. Possess the skills to perform graphic works of any level

1	Name of course	Reliability of TV and radio electronic devices
2	Code of course	NTA 4305
3	Cycle of course	AS ES
4	Amount of credits	6
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	4
8	Prerequisites	Mathematics I, II. Physics, engineering mathematics, Electrical circuit theory, Digital and Microprocessor technics1. 2.
9	Postrequisites	Design and operation of telecommunications networks, satellite and RRS.
10	Course summary	Design and operation of telecommunications networks, satellite and RRS.

11	Learning outcomes	To know and understand: the main methods of calculating the reliability of radio automation systems in radio engineering systems for various purposes, as well as the principles of mathematical description, analysis and synthesis of radio automation, telemechanics and communication devices; Be able to: perform functional schemes based on the block diagram (mathematical model) of the RET reliability devices mathematical analysis, measuring equipment and programs, computer modeling with the use of linear and nonlinear automatic radio system methods for regulating stability and quality of performance, analysis and technical characteristics; Be able to: conduct an individual calculation of the reliability of RET for systems and elements, as well as calculate the reliability of radio-electronic systems using modern programs and computer modeling.

1	Name of course	Business planning
2	Code of course	BP 4306
3	Cycle of course	AS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	4
8	Prerequisites	The basis of the in-depth study of the course "Business Planning" is economic theory, Microeconomics, as the knowledge gained in the course of studying this discipline forms an idea of the principles and objectives of the market economy, scientific and economic approach, skills of independent research work.
9	Postrequisites	The discipline "business planning" forms the skills of full mastery of the methods of economic analysis in order to obtain high results in economic activities in the economy of the enterprise, accounting, business valuation.
10	Course summary	The essence and objectives of the discipline Business Planning. The business plan and its basic structure. Assessment of the product sales market. Competition. Marketing activity plan. Production plan. Organizational plan. Financial plan. Legality of the plan. Risk and safety assessment.
11	Learning outcomes	Studied ZBul disciplines students need biliu: market change in the industry; cost calculation methods; calculation of tariffs for the services of social enterprises; Accounting standards applied in the Republic of Kazakhstan; methods for calculating the cost of production produced by social enterprises; methodology for calculating investment programs; methodology for solving optimization problems; using high-level approaches to the design of computational programs; choose a successful numerical method for setting a specific problem and make sure that it is reliable and accurate

1	Name of course	Satellite and radio relay communication system
2	Code of course	SRSS 4304
3	Cycle of course	AS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	4
8	Prerequisites	Physics, theory of electrical communication, antenna-feeder devices and radio-wave broadcasting
9	Postrequisites	Design and operation of telecommunications networks
10	Course summary	features of radio wave propagation in outer space on Earth. Satellite communication system; basic principles of construction; orbit parameters;types of orbit. The main characteristics of the structure of space stations. Block diagram of the land plot. The VSAT system. Energy calculation of the satellite communication network. Electromagnetic compatibility. Overview of existing and prospective PDAs. General principles of RRL construction. Principles of construction of radio relay equipment. RRL design.
11	Learning outcomes	To know: principles of functioning of space and ground radio communication systems and understanding of physical processes in them; theoretical bases of construction of systems of transmission of radio relay and satellite information; features of transmission of various signals on radio channels; modern and perspective directions of development of radio communication. Additional knowledge: performing calculations for the design of networks and radio communications in accordance with the requirements of technical characteristics; performing calculations, designing radio relay and satellite transmission systems for special purposes; applying regulatory documents related to space and ground radio communication systems. Skills of operation of radio relay and satellite transmission systems and special communication facilities; skills of regulation and regulation of radio communication systems in production, installation and technical operation.

1	Name of course	Radio receiving and transmitting devices
2	Code of course	RRU 3309
3	Cycle of course	AS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	Radio engineering, electronics and telecommunications
7	Year	3
8	Prerequisites	Technologies of wireless communication, television and broadcasting.
9	Postrequisites	Reliability of TV and radio electronic equipment, technology for mounting printed circuit boards and surfaces.
10	Course summary	Functional diagrams of radio transmitting devices. There are external excitations of the Generator. Methods of digital modulation in modern radio communication and radio access devices. Problems in creating high-efficiency and high-quality power amplification of multi-frequency signals of the OFDM type and ways to solve them. The main technical indicators and the device of radio receivers. Frequency converters. General information about radio receivers. Drawing up a diagram. The main components of radio receivers. Radio broadcasting receivers, technical characteristics, design schemes. Television receivers.
11	Learning outcomes	Must know: tasks solved by radio control systems, the device of radio communication systems, telemechanical devices; Be able to: correctly navigate between automatic systems and telemechanical devices; Possess: the skills to study the main characteristics of devices; the choice of the necessary devices and systems in the given conditions.