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

Radio engineering and electronics

Nur-Sultan, 2021

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

Brief description of elective disciplines of the educational program

Risk management

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	RET
7	Year	1
8	Prerequisites	Biology, Chemistry in the scope of the school curriculum
9	Postrequisites	
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. Relationships of organisms with the environment and living conditions. V. I. 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. Potential, real and realized hazards of natural and man-made origin.
11	Learning outcomes	To study the laws of the existence, formation and functioning of biological systems at all levels-from the organism to the biosphere and their interaction with the environment. Be able to analyze the impact of environmental factors on the life of living organisms and the environment; Master the methods of analyzing environmental processes, setting specific tasks and priorities for environmental and social protection Be able to analyze the processes occurring in the components of the biosphere and use methods for detecting and quantifying the main pollutants in the environment to develop environmental protection measures. Correctly formulate and justify your point of view on current issues of life safety Learn the rules and methods of protection against environmental emergencies; Master the basic methods of individual and collective protection of life and health in emergency situations of peace and war. Determine the causes and signs of possible consequences from environmental emergencies Use the acquired knowledge about the laws of interaction between living organisms and the environment in practical activities for environmental protection and life safety.

1	Name of course	Fundamentals of the economics of 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	RET
7	Year	2
8	Prerequisites	Philosophy. Modern history of Kazakhstan. Mathematics.
9	Postrequisites	Business planning
10	Course summary	The subject of fundamentals of economics and law. Fundamentals of social production and economic systems. Forms of social economy, the emergence of money. The mechanism of functioning of the market system: demand, supply, price, and competition. Production, costs and income of the firm, factor markets. National economy: content, structure, and measurement 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. Civil law. Family law. Labor law. Criminal law
11	Learning outcomes	know the laws of economic and legal development; know the basic concepts created during the long evolution of economic thought; know the principles of functioning of the market mechanism of self-regulation and state influence on the economy; be able to systematize knowledge about the nature and forms of economic and legal phenomena and processes; be able to apply in practice the methods of scientific knowledge of economic and legal phenomena and laws; have the skills to analyze the state and trends of socio-economic development of the national and global economies; have the skills of an interdisciplinary approach to solving economic and legal problems; have the skills necessary for the implementation of subjective rights and legal obligations in various life situations.

1	Name of course	Digital signal processing
2	Code of course	COS 3223
3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	3
8	Prerequisites	Mathematics,II. Engineering mathematics, Theory of electrical circuits 2. Theory of electrical communication
9	Postrequisites	Wireless communication technologies
10	Course summary	Discrete signals. Discrete systems. Fundamentals of digital filtering. Filtering of random signals. Computational process and computational algorithms. Digital frequency filters. Digital filters with linear phase. Deconvolution of signals. Deconvolution filters. The wavelet transform. The wavelet function. Discrete Karunen-Loew transform. A digital filter that is optimal according to the maximum signal-to-noise ratio criterion. Special discrete random processes.
11	Learning outcomes	Know: Forward and inverse Fourier transform (PDFT and ODFT). Properties of DFT and ODFT. Z-transformation. Forward and reverse Z - transformation. The discrete convolution theorem. The structure of discrete filters. Frequency characteristics of filters. Amplitude-frequency and phase-frequency characteristics of FIR and IIR filters; Be able to: independently perform mathematical analysis of signal conversion in digital form; Own:acquire practical skills in the analysis and synthesis of typical digital circuits

1	Name of course	Programming in telecommunications and radio-electronic systems

2	Code of course	PTRS 3210
3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
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 switching networks.
10	Course summary	The Python programming language. Comparison operators in Python. Python advantages and disadvantages of the language. GUI (graphical user interface). Python data types. The equivalent of null in Python: None. Check for None. Basic modules in Python. Operations on files and directories. High-level functions for creating and reading archived and compressed files. Request for the size of the output terminal. Unittest module: we test our programs. Command-line interface. Test detection. Organization of the test code. Checks 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	Be able to: install and configure the pythonide programming environment; write simple and composite python expressions and objects in the environment; write python control constructs; create and apply custom functions; load python modules and call functions of this module; work with the module's reference information; create your own module using numerical methods as an example. Know: the features of the python programming language; the principles of working in the python programming environment; the basics of the syntax of the python programming language; the typing and structure of the main objects of the python language; the control constructs of the python language and the principles of their functioning, the rules for working with exceptions the structure of python modules and the principles of working with them. Possess: skills of correct writing of the main objects of the python language; skills of writing syntactically correct expressions in python; skills of writing syntactically correct control constructs in python; skills of using ready-made and creating your own modules

1	Name of course	English for special purposes
2	Code of course	AYaDSC 2217
3	Cycle of course	BS ES
4	Amount of credits	6

5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	2
8	Prerequisites	"Foreign language" in the bachelor's degree level B1-B2
9	Postrequisites	Subjects in the specialty in a foreign language
10	Course summary	The course program is designed for the amount of teaching-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 dictionary-1600-2000 words, passive dictionary-400-500. The formation of the ability to read with almost complete understanding (level B1) and with full understanding (level B2) authentic thematic texts and in the specialty. The formation of the ability to write an essay of 250-500 words in the specialty, the formation of the ability to write an exposition of the read text using special terminology. The formation of the ability to perceive authentic messages containing professional information by ear. duration from 1.5 to 4.5 minutes. The formation of the ability to convey the content of the text (10-12 sentences), using adequate language tools, including special vocabulary and academic vocabulary, to form the skills of participation in a dialogue or polylogue, conducting a discussion..
11	Learning outcomes	According to the results of the development of the program, the student, depending on the level of training, at the time of completion of the course, reaches the level B1-(IELTS4.0-5.0) or B2 - (IELTS5. 5-6. 0) and the formed skills for solving problems of professional, interpersonal and intercultural interaction

1	Name of course	Electromagnetic fields and waves
2	Code of course	EPV 2218
3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	2
8	Prerequisites	Physics, Mathematics
9	Postrequisites	Satellite and radio relay and communication systems

10	Course summary	Basic laws of electrodynamics. The wave equation for the electromagnetic field. Plane electromagnetic waves in homogeneous and isotropic media Plane electromagnetic waves in media with frequency dispersion. Wave phenomena at the interface of media. Guided electromagnetic waves. Rectangular metal waveguides. Round metal waveguides. Volume resonators.
11	Learning outcomes	Know the basics of the theory of electromagnetic processes occurring in various environments, in electromagnetic energy transmission lines and linear microwave devices; Be able to apply theoretical knowledge to solve specific physical problems and situations in radio communication systems, analyze the results of a physical experiment in the field of electromagnetic waves; Possess the skills of using methods for solving specific problems in the field of the theory of electromagnetic wave transmission and the application of the laws of propagation of electromagnetic waves of various ranges in the design and operation of radio communication systems.

1	Name of course	Digital devices and microprocessor technology 2
2	Code of course	CUMT 3215
3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	3
8	Prerequisites	Mathematics 1, 2. Theory of electrical circuits. Digital devices and microprocessor technology 1. Electronics and circuitry 1,2.
9	Postrequisites	Software engineering. Embedded systems.Digital signal processing.Design on FPGA.Internet of Things

10	Course summary	Know: the main types and circuitry of functional units of digital and microprocessor technology; the current state and prospects for the development of digital and microprocessor technology. Be able to: select the element base and circuit solutions for the development of digital devices of varying degrees of complexity and purpose; design and develop various functional units of digital and microprocessor technology; develop algorithms for the functioning of digital and microprocessor devices. Possess the skills of: practical work with documentation and reference information on digital and microprocessor devices; designing specific devices in accordance with the technical task;creating and debugging programs for the microprocessor in a low-level language.
11	Learning outcomes	Basic definitions in microprocessor systems. Classification of MPs. The Von Neumann principles. The architecture of the IPU. Memory in MPS. Classification of IPU teams. The composition of the MPS and EMF teams. EMF structure. EMF pin diagram and the purpose of the main elements. Programming of the MPC. The ASSEMBLY language. Basic concepts. Interrupts in the MPC and working with them. Stack in the MPC and work with it. The software model of the MP. I / O interfaces of the MPC. The main stages of documenting IPU programs. Develop projects in the professional field and their elements in accordance with the terms of reference and regulatory and technical documentation, as well as justify project solutions and present the results of the work.

1	Name of course	Electronics and circuitry 2
2	Code of course	ES 3214
3	Cycle of course	БД КВ
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
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. Algebra of logic. Logical messages, logical operations, the simplest logical elements . Basic logic elements. Logical data types microchips. The main parameters of the IMS. Combinational logic circuits. Varieties of KLS. Sequential integral KLS. Pulse distributors. Counters with an arbitrary score coefficient. Pulse counters. Digital-to-analog converters (DACs). Analog-to-digital converters (ADCs).
11	Learning outcomes	Know: electronic pulse devices; characteristic features of the algebra of logic; logical operations and their purpose; varieties and circuit implementation of the simplest logic elements; basic logic elements; basic logic types and their circuit implementation; combinational logic circuits(KLS); integrated KLS; sequential integrated electronic devices; pulse counters; digital-analog and analog-to-digital converters. Possess: current information about the problems and prospects of development of electronic devices of circuit engineering; methods of analysis and calculation of integrated electronic devices; Be able to: choose the necessary integrated electronic device; competently understand a wide variety of modern types of logic; navigate in the design of various circuit variants of integrated microchip technology; set goals and objectives in the field of modern microchip technology

1	Name of course	Radio engineering circuits and signals
2	Code of course	RCS 3212
3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	3
8	Prerequisites	Theory of electrical circuits 1, 2.
9	Postrequisites	Satellite and radio relay communication systems
10	Course summary	Classification of signals.Dynamic representation of signals. Geometric representation of signals. Generalized spectral representation of signals. Deterministic signals. Kotelnikov's theorem. The spectrum of a discrete signal.Modulated signals. Classification of types of modulation. Random signals.Elements of probability theory. Random processes and their probabilistic characteristics. The energy spectrum of a random process. Wiener-Hinchin theorem, Fundamentals of the theory of linear-parametric chains. Discrete signal processing and digital filters. Optimal linear signal filtering
11	Learning outcomes	know and understand: basic concepts, definitions, terminology related to radio signals, circuits and devices for their formation and processing; be able to: calculate the physical, probabilistic, and numerical characteristics of messages, signals, and interference; possess: the application of the basic provisions of the course to solve practical problems of analysis and synthesis of devices of radio engineering systems and transformation into them

1	Name of course	Electro-radiomaterial Science
2	Code of course	Ele 2219
3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	2
8	Prerequisites	Mathematics. Physics.
9	Postrequisites	Fundamentals of micro-and nanoelectronics. Physical fundamentals of electronic engineering materials, Special issues of micro, nano and optoelectronics
10	Course summary	General information about electronic equipment materials. Types of communication in 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. Proprietary and impurity semiconductors. Electrophysical phenomena in semiconductors. Silicon. Silicon carbide. Solid solution-based semiconductor compounds. Dielectrics. Active dielectrics. Ferroelectrics. Piezoelectrics. Pyroelectrics. Electretes. Liquid crystals. Materials for solid-state lasers. Magnetic materials.
11	Learning outcomes	Have an understanding of the classifications of electrical materials, the structure features, the main properties, the influence of external factors on the change in properties, the scope of application in electronic devices. To know and understand: the physical nature of the processes occurring in conducting, semiconductor, dielectric and magnetic materials when they are used in various devices and devices of solid-state electronics. Be able to: correctly navigate among a wide range of electronic equipment materials; Possess: the skills of research of the main characteristics of materials; selection of materials for electronic equipment of a given purpose, taking into account the permissible loads, the influence of external factors; selection of components for use in electronic equipment, taking into account the conditions of its operation, design and manufacturing technology. Acquire practical skills in the use of measuring instruments for the parameters of materials and components of electronic equipment, analysis of the main characteristics of electronic equipment materials.

1	Name of course	Radio Automation and telemetry
2	Code of course	RT 3211
3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	3
8	Prerequisites	Mathematics 1. Physics. Engineering mathematics, Theory of electrical circuits 1, 2. Electromagnetic fields and waves..
9	Postrequisites	Electronics and circuitry 2. Radio circuits and signals. Programming in TV and radio electronic devices and systems.CAD of electronic devices.Theory of digital communication. Wireless communication technologies, Satellite and radio relay systems and communication systems.
10	Course summary	Automatic control systems. Differential equations. transition and transfer functions. Frequency, logarithmic frequency characteristics of RA. Typical links of the system. Oscillatory, integrating links. Investigation of the stability of linear automatic control systems. Stability criterion Mikhailov. Converting a message to a signal and separating the elements. Election methods and group selection. The main nodes of the TU-TS devices. Amplification and translation points. Scrambler, decryptor node.
11	Learning outcomes	setting up telecommunications devices; on the principles of building automatic telephone exchanges; on the principles of establishing connections; on the construction of structural schemes; on control devices; on the general characteristics and composition of equipment for electromechanical, quasi-electronic PBX; on signaling on communication networks. Know and understand: the principles of building automatic systems of various types and the distribution of information on networks, the principles of analog and digital switching, the principles of switching when integrating different types of information, the principles of ACS, design and operation of digital automation systems. Be able to: calculate the load on the nodes of standard links, analyze the reliability of control systems, design the network automated control system. Possess the skills of working with control systems, planning and design skills, operation of telemechanics systems; work with Have an idea of the basics of automatic control; about the methods of switching systems, design skills, operation of automatic systems and software control..

1	Name of course	Printed circuit board and surface mount technology
2	Code of course	TPPPM 4214
3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	4
8	Prerequisites	Theory of electrical circuits 1, 2. Electronics and circuitry 1, 2. Digital devices and microprocessor technology 1, 2.
9	Postrequisites	Thesis / Thesis Project
10	Course summary	Development of printed circuit board manufacturing technology. Installation of electronic circuits in the housing and high-density interconnects. Physical characteristics of printed circuit boards. The process of designing printed circuit boards. Built-in components. High-density interconnects. High-density interconnect (HDL) technology. Surface-mounted switching boards. Design of surface-mounted switching boards. Testing of mounted boards. Design of flexible printed circuit boards. Special designs of flexible boards..
11	Learning outcomes	Know: electrical engineering, electronics, Circuitry; principles of building electronic devices and systems; features of the CAD company AlteraMax+PlusII and QuartusII, CAD WebPACKISE and Vivado; standards of the specification languages VHDL, Verilog and SystemC. Be able to: understand the operation of components and blocks of electronic systems. Possess: skills of system scientific analysis of problems arising in the design of electronic systems; skills of working with basic methods in the field of electronic systems. Demonstrate the ability and readiness: to solve the problems of design and production technology of printed circuit boards and surface mounting

1	Name of course	Digital communication Theory
2	Code of course	TCS 3227

3	Cycle of course	BS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	3
8	Prerequisites	Wireless communication technologies, Radio transmitting and receiving devices, the Internet of Things. Reliability of tele-electronic equipment.
9	Postrequisites	Mathematics 1,2. Information and communication technologies. Physics. Engineering mathematics. Theory of electrical circuits 2. Digital devices and microprocessor technology 1. Theory of electrical communication.
10	Course summary	Functional diagram and basic elements of the digital communication system. Compliance with the OSI model. Classification of signals. Analysis of the communication channel. Interference and noise. Methods for registering a digital signal. Sign encoding. Pulse modulation. Signal-to-noise ratio. Basic principles of error detection and correction. Hamming codes. Convolutional codes. Iterative and cascading codes. The concept of turbocoding. Scrambling. Group and element-by-element synchronization. Feedback systems
11	Learning outcomes	Have an understanding of digital information as an object of transmission, distribution, transformation, storage, or direct use. Know and understand: the principles of building functional digital communication nodes, the laws of processing, transmitting and receiving messages, hardware and software methods for improving the noise immunity and transmission speed of digital communication systems, methods for effective use of communication channels, methods for optimizing signals, the main stages of forming research and development technical documentation. Be able to: conduct a mathematical analysis of the processes of formation, transmission and reception of digital information; obtain mathematical models of signals, communication channels and determine their parameters; evaluate coding methods; calculate the bandwidth, information efficiency and noise immunity of telecommunications systems, justify the parameters of the main characteristics of digital communication systems devices. Master: methods of modeling, optimization and calculation of bandwidth, error protection, channel efficiency in the transmission of discrete messages in modern networks; methods of analysis and search for implementation options for digital information transmission systems. Acquire practical skills: computer modeling of signals, functional devices and digital communication systems in general.to specific scenarios to possess the skills of designing the Internet of things

1	Name of course	Internet of Things
2	Code of course	IV 3313
3	Cycle of course	AS ES
4	Amount of credits	3
5	Level of preparation	Undergraduate studies
6	Department	RET

7	Year	4
8	Prerequisites	Engineering mathematics. Information and communication technologies. Algorithmization and programming in high-level languages, Electronics and circuitry 1. Digital devices and microprocessor technology 1. Digital devices and microprocessor technology 2. Digital communication theory. Wireless communication technologies
9	Postrequisites	SWM
10	Course summary	Introduction to the Internet of Things. IoT application scenarios. Data transfer technologies for iOS. IoT hardware. Standard interfaces. Data processing, cloud storage. Practical work with devices
11	Learning outcomes	Have an understanding of the Internet of Things (IoT). Know: the principles of the organization and functioning of the "Internet of Things". Understand: the concept of IoT and M2M. Be able to: work with microcontrollers and basic debugging boards, distinguish between existing It technologies and apply them to specific scenarios Possess the skills of: designing Internet of Things systems.

1	Name of course	Reliability of tele-electronic equipment
2	Code of course	NTA 4306
3	Cycle of course	AS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	4
8	Prerequisites	Mathematics III. Physics. Engineering mathematics. Theory of electrical circuits 1,2. Digital devices and microprocessor technology 1,2.
9	Postrequisites	Design and operation of telecommunications networks. Satellite and RRL.

10	Course summary	The problem of assessing the reliability of REA. Basic concepts of the theory of reliability of REA. Reliability of the element of REA technical systems. Mathematical apparatus of the REA reliability theory. Concepts of failure and recovery of REA elements. Distribution functions of the uptime of the REA. Determination of the reliability of technical REA systems by the reliability of its elements. Hardware redundancy. Factors determining the reliability of REA. System reliability with REA recovery
11	Learning outcomes	Know: the main methods of calculating the reliability of radio automation systems in radio engineering systems for various purposes, as well as the principles of construction, mathematical description, analysis and synthesis of radio automation, telemechanics and communication devices. Be able to: make a structural diagram of the device reliability (mathematical model) based on the functional diagram and technical description, perform an analysis of the stability and quality of regulation of linear and nonlinear automatic radio systems using mathematical analysis methods, measuring equipment and computer modeling programs. Own: independently perform calculations of the reliability of the RET, including using modern computer modeling programs

1	Name of course	Software Engineering
2	Code of course	PI 3302
3	Cycle of course	AS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	3
8	Prerequisites	ICT. Engineering mathematics. Algorithmization and programming in high-level languages, Programming in teleradio-communication devices and systems.
9	Postrequisites	Embedded systems, the Internet of Things
10	Course summary	Life cycle models and profiles. Life cycle processes of software tools for microprocessor and embedded systems. Project management of software tools for automation systems. Basic software engineering processes. General issues of software engineering process execution. Methods and tools of software engineering. Formal and applied models of software engineering. Using the methodology of Systems Theory and System Analysis in software engineering.

11	Learning outcomes	To know:modern trends in the development of computer science and computer technology, computer technologies; the basics of creating information systems and the use of new information technologies for information processing;software life cycle; object-oriented programming; theories and methods of classification; elements of complexity theory. Be able to: use the rules for building and reading drawings and diagrams; methods and tools of computer graphics and geometric modeling; graphic packages for creating object models; principles of organization, structure of technical means of computer graphics systems; basic methods and algorithms for forming and converting images; report and request Possess: methods and tools for the development and execution of technical documentation. To perform graphic works of any level of complexity and to make the accompanying design documentation, skills of drawing up design and technical documentation of production with the use of software and technical means of computer graphics

1	Name of course	Business planning
2	Code of course	BP 4304
3	Cycle of course	AS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	4
8	Prerequisites	Fundamentals of economics and law
9	Postrequisites	Diploma design
10	Course summary	The business plan of an agro-industrial enterprise as the basis for the implementation of an entrepreneurial idea. Business planning as an element of the company's economic policy. Organization of business planning. The place and role of the business plan in business management. Analytical sections of a typical business plan for enterprises. Key sections of a typical business plan. The main elements of business planning. Business planning technology. Management business plan of an agricultural enterprise. Business plans of projects and solutions to practical problems of business management.

11	Learning outcomes	To know: - features of business planning as a type of planning; - goals, objectives, functions and main stages of business planning; - types of business projects and features of different types of business plansb; - basic requirements for the development (including international standards) and the structure of a typical business plan; - necessary information support for the development of the business plan and its sources; - basic methods of developing individual sections of the business plan; - methods for analyzing, monitoring and evaluating the effectiveness of business plans; - ways to promote business plans to the market of intelligent services; Be able to: - formulate a business idea; - determine the type of necessary business plan depending on the proposed business project according to the specifics of production; - choose the optimal structure of the business plan, depending on its purpose; - to justify the feasibility (feasibility) of a particular business project from the point of view of marketing, organization, and finance; - calculate economic indicators based on standard methods and the current regulatory framework; - use sources of economic, social, and managerial information; - evaluate the effectiveness of the proposed business project; - promote the business plan to the market of intelligent services; Own: - methodology of economic research; - modern methods of collecting, processing and analyzing economic and social data.

1	Name of course	CAD of electronic devices
2	Code of course	SAPSEU 4305
3	Cycle of course	AS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	4
8	Prerequisites	Theory of electrical circuits 1,2. Electronics and circuit engineering 1,2. Digital devices and microprocessor technology 1
9	Postrequisites	Printed circuit board and surface mount technology
10	Course summary	Integrated circuit design methodology. Design principles. Design methods. Stages of designing electronic devices. Development of the specification. Logical design. Circuit design. Topological design. Component design. CAD architecture of electronic devices. Software design tools. VLSI design routes. Automation of design of semi-custom VLSI. Automation of custom VLSI design. CADENCE design tools. SYNOPSYS design tools. MENTOR GRAPHICS design tools.
11	Learning outcomes	Know the terms and definitions of the design process, the basic principles and methods of CAD organization, the basic modeling methods, Be able to evaluate the integrated parameters of the device and the electrical modes of the circuit elements, develop a program and methodology for testing electronic devices on the developed models. Possess methods and algorithms for designing electronic devices based on standard design procedures, techniques for analyzing design results, and skills in working with special literature.

1	Name of course	Television and radio broadcasting
2	Code of course	RT 3211
3	Cycle of course	AS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	3
8	Prerequisites	Digital devices and microprocessor technology 1. Antenna-feeder devices and radio wave propagation..
9	Postrequisites	.Packet and hybrid switching networks. Technologies of transport communication networks. Satellite and radio relay systems and communication systems. Radio transmitting and receiving devices. Digital signal processing.
10	Course summary	Converting an optical image into an electrical signal. Block diagram of the television system. Principles of converter construction. TV signal sensors and their characteristics. Color television systems. Colorimetric color detection. Digital representation of image signals. Compression of digital television signals. Video compression according to MPEG-1,2,4 and MPEG-7 standards. Digital video signal modulation. Digital TV broadcasting DVB. Radio broadcasting systems. Radio broadcasting in the DV, SV and HF bands. Digital radio broadcasting.
11	Learning outcomes	Know: the principles of building digital television and radio broadcasting networks, the features of their functioning and operation, standards, frequency ranges and wavelengths; the basics of forming digital television and audio signals and transmitting them through various communication channels; the composition of the equipment of TV and radio centers. Be able to: calculate the required frequency band, the amount of equipment for tele-radio systems, analyze the reliability of systems, plan and design digital television and radio broadcasting networks; Possess: the operation and configuration of TV and radio systems, the skills of planning, design, operation of these systems and methods for determining the performance and quality indicators of systems.

1	Name of course	Wireless communication technologies
2	Code of course	TBS 3309
3	Cycle of course	AS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	3
8	Prerequisites	Mathematics 1,2. Engineering mathematics. Physics. Electromagnetic fields and waves. Theory of electrical circuits 2. Digital communication theory, Digital Signal processing
9	Postrequisites	Internet of Things. Satellite and radio relay systems and communication systems.
10	Course summary	Classification of wireless communications Methods of spectrum conversion using a carrier. Amplitude, frequency, and two-position phase manipulation. Coherent and incoherent detection. Multi-position phase and quadrature amplitude modulation. Multiple access. Methods of spectrum expansion. Features of the transmission channel in wireless systems. Models for calculating signal power loss. 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. LP VAN technology.
11	Learning outcomes	Have an understanding of the principles of operation, construction and application of wireless networks and systems based on them. Know and understand: modulation methods; access methods in wireless networks; spectrum extension technologies; protocols of the physical and channel layers of the radio interface of wireless communication networks; architecture, specifications, methods of building and applying wireless communication technology. Be able to: perform the necessary calculations for the development of a wireless communication system; conduct frequency planning of a mobile radio network; calculate the required equipment of a wireless system; select the required parameters of equipment for the organization of a wireless network; conduct a program analysis of the characteristics of wireless technologies; apply theoretical knowledge in practice. Possess: methods of modeling, optimization and calculation of wireless network systems; methods of analysis and search for implementation options for mobile radio communication systems. Acquire practical skills: computer modeling of signals, functional devices and wireless communication systems, experience working with real devices for organizing radio access.

1	Name of course	Radio transmitting and radio receiving devices
2	Code of course	RRU 4309
3	Cycle of course	AS ES
4	Amount of credits	5
5	Level of preparation	Undergraduate studies
6	Department	RET
7	Year	4
8	Prerequisites	Wireless communication, Television and radio broadcasting technologies
9	Postrequisites	Reliability of tele-electronic equipment, Technology of printed circuit boards and surface mounting.
10	Course summary	Functional diagrams of radio transmitting devices. Generator with external excitation. Methods of digital modulation in modern radio communication and radio access devices. Problems and ways to solve them in terms of building high-efficiency and high-quality power amplification of multi-frequency signals of the OFDM type. The main technical indicators and structures of radio receivers. Frequency converters. General information about radio receivers. Construction schemes. The main components of radio receiving devices. Broadcasting receivers, technical characteristics, block diagrams. Television receivers.
11	Learning outcomes	Know: problems solved by radio control systems, the design of radio communication systems, telemechanical devices; Be able to: correctly navigate among automatic systems and telemechanical devices; Possess: skills of research of the main characteristics of devices; selection of the necessary devices and systems in the given conditions.