CATALOGUE OF ELECTIVE DISCIPLINES
UNDERGRADUATE LEVEL

The abbreviated name of the cycles of disciplines	Name of disciplines and their main sections	The complexity of all loans
OC 1.2	**OPTIONAL COMPONENT (OC)**	**5**
1.	**Basis of the economy and business**	
	Social production. Essence, form, capital structure. Production costs. Production revenues in a market economy. The concept of business. Types of business activities. The theory of ownership, social forms of management. Goods, money. Social and economic system. The emergence of the market. Financial system. The role of the state in business development. Macroeconomics. Resource Saving. Cyclical economic development. Inflation and unemployment. Kazakhstan in the system of world economic relations.	
2.	**Bases of the law andanti-corruption culture**	
	The main regulations of the Constitution, the current legislation of the Republic of Kazakhstan; the system of government, terms of reference, objectives, methods of state regulation of the economy, the role of the public sector in the economy; financial law and finance; the interaction mechanism of substantive and procedural law; the essence of corruption, the reasons for its origin; moral, legal and legal liability for corruption offenses; current legislation in the field of anti-corruption	
3.	**Health and safety of the person**	
	Life safety, its main regulations. Hazards, emergencies. Risk analysis, risk management. Human security systems. Destabilizing factors of modernity. Social dangers, protection from them: dangers in the spiritual area, politics, protection from them: dangers in the economic area, danger in everyday life, everyday life. The system of bodies for life safety and legal regulation of their activities	
4.	**Ecologyandsustainabledevelopment**	
	The main patterns of the functioning of living organisms, ecosystems of various levels of organization, the biosphere as a whole, their stability; interactions of the components of the biosphere and the environmental consequences of human activities, especially in conditions of intensified environmental management; modern image of concepts, strategies and practical tasks of sustainable development in various countries and the Republic of Kazakhstan; problems of ecology, environmental protection, sustainable development	
BD 2	**CYCLE OF BASIC DISCIPLINES (BD)**	**112**
	OPTIONAL COMPONENT (OC)	**57**

	Analytical geometry and linear algebra	**5**
1	Elements of set theory. Algebra of matrices. Systems of linear equations. Determinants. Polynomials in one variable. Complex numbers. Scalar, vector and mixed product of vectors and their applications. The coordinate method on the plane. Lines on the plane. Second-order curves on the plane. Equations of surface and lines in space. Second order surface sand their canonical equations	
2	**Differential equations**	
	Problems leading to differential equations. First order differential equations. The theorem of existence and uniqueness of the solution of the initial problem. General theory of systems of differential equations. General theory of linear ordinary differential equations. General theory of systems of linear ordinary differential equations. Linear differential equations and systems with constant coefficients	**5**
3	**Probability theory and mathematical statistics**	**5**
	Basic concepts of probability theory. Conditional probability and independence. Random variables. Characteristics of discrete and continuous random variables. Limit theorems and their applications. Elements of mathematical statistics. Parameter estimation methods. Elements of the theory of correlation. Statisticalhypothesistesting.	
4	**Programming**	**4**
	Computer software. Local and global networks. Programming languages. Arrays. Boolean expressions. Cycle operators. Types of data. Input / output data. Algorithms. Principles of structured programming. Computeranimation. Computergraphics. Modernprogrammingmethods. Analyticalcomputing.	
5	**Basics of vector and tensor analysis**	**3**
	Vector space, its dimension and basis. Vector as a directed line segment. Scalar, vector and mixed products of vectors. Transformation of vector components while rotating the Cartesian coordinate system. Transformation of vector components in case of inversion of the Cartesian coordinate system. Definition of tensor. Basics of tensor algebra. Invariants of second-order tensors. Covarianceofphysicallawsintensorform. Tensorfields.	
6	**Electrodynamics**	**5**
	Charge density and current density. Field strength of stationary charges. Magnetic field induction. Lorentz force. The principle of superposition of fields. Electromagnetic induction. Maxwell's equations. The equation of the magnetic field. Electromagnetic potentials. Gauge invariance of potentials. Poisson's equations. Laplace's equations. The Maxwell stress tensor. The Umov- Poynting vector. Multipole decomposition. Electric dipole moment of the system. Vector potential. Energy density	
7	**Quantum mechanics**	**5**
	Necessity of transition for quantum concepts. Necessity for a probabilistic-static description of the motion of a quantum particle. Wave function. The principle of superposition. Dynamic variables in quantum mechanics. Quantization rules. Operators of physical quantities. Eigenfunctions and eigenvalues of operators. Dynamic equations of quantum mechanics. Schrödinger equations. Stationary states of quantum systems. The law of conservation in	

	quantum mechanics. Approximate methods in quantum mechanics. Spin particles in non-relativistic quantum mechanics. Features of the equilibrium description of a particle system.	
8	**Statistical physics and fundamentals of physical kinetics**	**5**
	Gibbs method, the kinetic theory of gases, the application of the second law of thermodynamics, nonequilibrium states, relaxation, and the study of transport phenomena. The theory considers the stationary distribution function, the Maxwell-Boltzmann distribution, the Gibbs kinetic distribution. The application of the laws of distribution studies the state properties, thermal conductivity of gases and solids. The theory of fluctuations is applied to macroscopic bodies. The basics of statistical physics that is developed on the basis of classical and quantum statistics. Applying the general statistical theory for ideal and non-ideal gases, solids, for electrons in metals, study of the fluctuation phenomena and Brownian motions.	
9	**Methods of mathematical physics**	**5**
	The application of the mathematical apparatus to physical phenomena. Measure each physical property. Uses values such as its length, area, volume, mass, time, temperature, and energy. For a quantitative description of the speed of motion mathematical quantities - directed segments, or vectors are used. To study the properties of complex phenomena, mathematical fields such as a region in space, each point of which corresponds to a certain value of a certain physical quantity. Difference between stationary and non-stationary fields. Mathematical apparatus as a system of differential equations. Theoryoflinearalgebra.	
10	**Nuclear physics**	**5**
	The basic laws and phenomena of the microworld; basic methods of nuclear physics research; types of nuclear reactions and their laws; the laws of radiation passing through the matter; sources and detectors of nuclear radiation. Conservation laws in nuclear reactions. Isospin. Kinematics of nuclear reactions. Nuclearfission. Thesimplesttheoryofdivision. Nucleosynthesis.	
11	**Electronics**	**5**
	The main elements of radio electronic equipment, a statement of the basis of semiconductor devices and the principle of operation of the most important semiconductor devices used as discrete components of electronic devices and integrated circuits, as well as principles for constructing basic radio engineering circuits based on them. The most important processes occurred in semiconductor devices.	
12	**Basics of nanotechnology**	**5**
	Introduction to the nanoworld. Nanomaterials. Methods for obtaining and studying properties. Interdisciplinary problems. Scientific basis of nanotechnology. Quantum effects. Multidisciplinarity and integration. Equipment for the study of the characteristics of nanostructures. Methods for obtaining nanoparticles and the study of their properties.Carbonnanomaterials. Applicationsofnanomaterials.	
	CYCLE OF PROFILE DISCIPLINES	**60**
	OPTIONAL COMPONENT (OC)	**20**
1	**Mathematical and computer modeling of physical processes**	**5**
	The problems of modeling physical processes and phenomena, with the basic computational methods used in solving physical problems and in processing experimental data, estimating the observational error of the results of	

		calculations, the formation of practical skills in programming basic mathematical algorithms used in modeling physical phenomena. Practical programming skills for basic mathematical algorithms used in modeling physical phenomena. Such skills are an extremely important part in the system of modern training of physicists in modern conditions, the development of computer technology directly in a physical experiment, as well as in creating a numerical model of a real physical phenomenon.	
2		**Electrical engineering**	**5**
		The concept of single-phase AC. The principle of obtaining a sinusoidal EMF. Voltage, current, resistance triangle.Voltage resonance. Electrical measuring instruments. Classification. The working principle of single phase transformer. Basic circuits of semiconductor diodes and thyristors. Operating three phase induction motors on single phase supply. The use of AC and DC motors in the national economy.	
3		**Experimental methods of nuclear physics**	**5**
		Nuclear radiation. Passage of particles through matter. Ionization loss. Primary ionization. Full ionization. Passage of electrons through matter. Passage of gamma rays through matter. Electromagnetic shower. Wilson cloud chamber. Types of interactions. Hadron passage through matter. Quarks. Leptons. Nuclearmileage.	
4		**Elementary particles and high energy physics**	**5**
		Elementary particle interactions at collision energies. Experiments in high energy physics, accelerators of charged particles and nuclear reactors. The source of high-energy particles are cosmic rays. In non-accelerator experiments with cosmic rays, the properties of neutrinos and the behavior of particles at ultrahigh energy (air showers) are mainly studied.	