JSC "Academy of Logistics and Transport"

APPROVE
Chairman of the ALT AC
_____ S. Amirgalieva

Decision of the Academic Council of ALT
«___» _____ 2022 y. (protocol № ___)

BACHELOR'S DEGREE ENTRANCE EXAM PROGRAM FOR FOREIGN CITIZENS IN EDUCATIONAL PROGRAMS

Group of educational programs:

B059- Communications and Communication technologies
B062- Electrical engineering and Power engineering
B063- Electrical Engineering and Automation
B065- Motor vehicles
B165- Backbone networks and infrastructures
B166 – Transport facilities

Almaty, 2022

The program of the entrance exam was discussed and received a positive decision at the meeting of the Department of "Energy", protocol №10 from«22» 06 2022.

Head of the Department of "Energy" _____ **K.Zh. Kalieva**

The program of the entrance exam was discussed and received at the meeting of the Council of the Institute "Automation and Telecommunications", Protocol No. 10 of June 23, 2022.

Chairman of the Council of the Institute "Automation and Telecommunications" _____ **A.Toigozhinova**

CONTENT

1. The purpose of the interview for a group of educational programs

The purpose of the interview for groups of educational programs is to determine the theoretical and practical readiness of the applicant for bachelor's degree, the level of compliance of knowledge, skills and abilities with the requirements of bachelor's degree in the field of training.

This program lists the basic physical concepts corresponding to the high school physics course that an incoming student should possess, as well as a list of recommended literature for preparation.

During testing, you can use: a pen, a pencil, a simple calculator (as a separate object, not embedded in another object, for example, in a mobile phone or smartphone). The use of specialized literature and mobile phones / smartphones is not allowed.

2. Interview questions for undergraduate admission to foreign applicants for undergraduate educational programs:

6B06208-Telecommunication systems and railway communication networks
6B06209-Radio engineering, electronics and telecommunications
6B07121-Electrical power engineering
6B07120 – Automation and control
6B07128 - Railway track and trackside
6B07129 - Bridges, tunnels and subways
6B07130–Highways and airfields
6B07131 - Linear pipelines
6B07116 - Wagons
6B07117 - Locomotives
6B 07119 - Cars and automotive industry
6B07118 - Track and road machines

BASIC CONCEPTS

I. KINEMATICS

1. Mechanical movement. The frame of reference. The relativity of motion. The radius is a vector. Trajectory. Way. Moving. Average and instantaneous speed. The direction of speed. Tangent to the trajectory. Uniform movement. Galileo transformations. The law of addition of velocities and the transition to different reference systems. Graphic representation of movement. The physical meaning of area and slope.

2. Acceleration. Equidistant motion. The dependence of kinematic quantities among themselves in equidistant motion. Vector and coordinate formulas. Graphs of changes in velocity, coordinates, and acceleration over time in equidistant motion. Movement in a homogeneous gravity field.

3. Curvilinear motion. Instantaneous acceleration as the sum of tangential and normal. The radius of curvature of the trajectory. Expression of the day of instantaneous normal acceleration. Movement in a circle. Angular velocity and acceleration. Tangential and normal accelerations when moving around a circle.

4. Movement with connections. Kinematic connections: thread, rod, no slippage, sliding without separation. Kinematics of rotation of an absolutely rigid body (plane-parallel motion). Instantaneous axis of rotation. The angular velocity vector.

II. DYNAMICS

1. The basic laws of the dynamics of a material point. The main task of dynamics. Interaction. Inertial reference frames and Newton's first law. Mass, force, and Newton's second

law. The primacy of the concepts of mass and force. Force as a measure of the interaction of material bodies and Newton's third law. "Real" forces: field, elasticity (Hooke's law), resistance forces (dry friction, viscous, hydrodynamic). Body weight. The dynamics of the curvilinear motion of a point.

2. Impulse. Center of mass. The momentum of a point and a system of points. The law of changing the momentum of a material point. An impulse of power. The law of changing the momentum of a system of material points. The theorem on the motion of the center of mass. The law of conservation of momentum. Movement of systems of variable composition. The Meshchersky equation.

3. Mechanical work. Energy. Kinetic energy of a material point. The kinetic energy theorem. Potential and conservative systems. The potential energy of a point in a homogeneous field and a spring. Mechanical energy and the law of its change. The law of conservation of mechanical energy. Galileo transformation for kinetic energy and work.

4. Collisions. Absolutely elastic and absolutely inelastic collisions. What does the mechanical energy of colliding bodies go into if it is not conserved? The center of mass system. Reduced mass.

5. The law of Universal gravitation. The law of gravitational interaction of point masses and balls. The field of gravity. The Gauss theorem. Potential energy in the Coulomb field. Kepler's laws. Cosmic speeds. Satellites.

6. Static. Conditions of equilibrium of a body under the action of a plane system of forces.

III. THERMODYNAMICS AND MOLECULAR PHYSICS

1. Statistical and dynamic methods of describing systems. Micro and macro parameters. Equilibrium and nonequilibrium states. Reversibility. Mechanical and thermal equilibrium. The dependence of the equilibrium time (relaxation time) on the size of the system. Macroparameters of molecular physics: pressure, volume, temperature, concentration.

2. Empirical gas laws. The laws of Charles, Gay-Lussac, Boyle—Marriott, Dalton, Avogadro, their approximate nature and scope of applicability. Absolute temperature. Combining gas laws into the Mendeleev—Clapeyron equation. Permanent

Boltzmann. Mole. Avogadro number. Gas constant. Tasks: the average molar mass of a mixture of gases.

3. Molecular kinetic theory. The main provisions of the MKT and their experimental justification. The mass and size of the molecules. The average distance between the molecules. An ideal gas is a model of a real gas. The basic equation of the MCT of an ideal gas. The average quadratic speed. Temperature in MKT. Explanation of gas laws. The length of the free run. Diffusion. Thermal conductivity and viscosity of the gas. Equidistribution of energy by degrees of freedom. The internal energy of an ideal gas. Distribution of molecules by velocities (Maxwell's)

4. The first beginning of thermodynamics. Thermodynamics and MKT. The first principle of thermodynamics is the general law of conservation of energy. Internal energy. Two ways to change the internal energy. Work and the amount of heat. State functions. Applying the first principle to isoprocesses. Heat capacity. The Mayer formula.

5. The second beginning of thermodynamics. Irreversibility. Nonequivalence of mechanical and internal energies. The probabilistic nature of irreversibility. Examples of irreversible processes. Principles of operation of cyclic heat engines. The role of the refrigerator. efficiency. Perpetual motion machines of the first and second kind. Examples of non-cyclic heat engines. Two formulations of the second principle (Thomson—Planck and Clausius and their equivalence). The Carnot cycle is the "only" reversible one. Thermodynamic temperature scale.

6. Phase transitions. Crystalline and amorphous bodies. Types of phase transitions. Dynamic phase equilibrium. Saturated steam. Humidity. Dew point. Phase diagrams in P—T and

P-V coordinates. Triple and critical points. The dependence of the boiling point of the liquid on the pressure. The Clapeyron—Clausius equation.

7. Hydrostatics. Deformations of the liquid. Newtonian and non-Newtonian fluids. Conditions of fluid equilibrium. Pascal's law. Pressure in a liquid located in a homogeneous gravity field. Communicating vessels. Archimedes' law. Swimming bodies. The center of gravity of the floating body and the center of pressure. Stability. Pascal's paradox.

8. Surface tension. The surface layer. Surface energy. Surface tension coefficient (two definitions and their equivalence). Wetting. The marginal angle. Liquid in the capillary. Capillary length. Laplace pressure. Saturated vapor pressure over a curved surface. The internal energy of the film. The heat of film formation.

9. Elasticity. Hooke's law. The dependence of stiffness on size. Young's module. Poisson's ratio. Modules of comprehensive and one-sided compression. The energy of elastic deformation.

IV. ELECTROSTATICS

1. The basic laws of electrostatics. Fundamental interactions. Two kinds of electric charges. The law of conservation of charge. The principle of superposition. Coulomb's law. Systems of units.

2. Electric field. Long-range and short-range. Tension. Trial charge. Force lines and their properties. Calculation of the fields of the plane, cylinder and sphere by the method of force lines. The area of applicability of the infinite plane model. The field of a ball and a flat layer.

3. Gauss' theorem. Solid angle. Flow. Proof of the Gauss theorem. The relationship of the flow with the force acting on a uniformly charged plane. Symmetry considerations. The impossibility of stable equilibrium of a system of point charges.

4. Potential. Conservativeness of the point charge field. Conservativeness of an arbitrary electrostatic field. Potential. Potential difference. Equipotential surfaces and their orientation relative to the lines of force. The connection of tension and potential. The energy of a system of point charges. Interaction energy and total energy. Boundary conditions for E.

5. Guides. Properties of conductors in an electrostatic field. The uniqueness theorem. Screening. Earth. A conductor in an external non-electric field. The method of electrical images. A sphere in a homogeneous field.

6. Pressure and energy of the field. The energy density of the electric field, as a general formula for arbitrary fields. Field pressure.

7. Dipole. The dipole field. The dipole moment. The energy of the dipole in the external field.

8. Capacity. Capacitors. The capacity of the solitary conductor. The energy of the field of a solitary conductor, a capacitor. The capacitance of the capacitor. Features of the "flat capacitor". Connections of capacitors. The energy of the capacitor.

9. Dielectrics. Polar and nonpolar dielectrics. Polarizability. Explanation of the proportionality of E and P for polar and nonpolar dielectrics. The polarization vector and its properties. Susceptibility and permittivity. Two approaches to problems with dielectrics. The energy of the field in the dielectric. Boundary conditions for E.

V. DIRECT CURRENT

1. The section of the chain. Conditions necessary for the existence of an electric current. The viscous friction model. Ohm's law in integral and differential form. The dependence of the resistance on the shape and size of the conductor. Difficulties of the classical theory of the conductivity of metals. The work of the resistance forces. It's Joule warm. Operation and current power. The distribution of charges on the surface of a direct wire with a current. Measuring instruments. Galvanometer, ammeter and voltmeter. Calculation of shunts and additional resistances.

2. Closed circuit. Outside forces, their necessity. Voltage, potential difference and EMF. Voltage drop. The Kirchhoff rules.

3. Current in media. The passage of current through electrolytes. Laws of electrolysis. Current in vacuum. Electronic lamps. Current in gases. Types of discharges. Current in semiconductors. Intrinsic and impurity conductivity, p-n junction. Bipolar transistor.

VI. MAGNETIC FIELD

1. Magnetostatics, magnets. Interaction of moving charges. Magnetic field. Magnetic field induction. The Lorentz force is a fundamental force in nature. Ampere power. The left-hand rule. The movement of charges in a magnetic field. Cyclotron and synchrophasotron. Mass spectrograph. The Bio—Savard law. The circulation theorem is an analogue of the Gauss theorem in electrostatics. The system of units. Magnetic properties of the substance. Dia-, para- and ferromagnets. Domains, hysteresis, Curie point. Magnetism is a quantum phenomenon. Magnetic flux. The inductance of a closed circuit is an analog of capacitance in electrostatics. The inductance of a solenoid is an analog of a flat capacitor in electrostatics. Toroidal coil.

2. Electromagnetic induction. The phenomenon of electromagnetic induction. Faraday's experiments. The law of electromagnetic induction. Electromagnetic rail generator and motor. Demonstration of external forces, voltage and potential difference at the source. The frame is in a magnetic field. Electromagnetic voltmeter and ammeter. The Lenz rule. A vortex electric field is a field without source charges. Self-induction. The energy of the magnetic field. Mutual induction. DC motors and generators. Relativity of electric and magnetic fields. The energy of the coil. The energy of the magnetic field. The coil as an element of the circuits. The EMF in the coil and the voltage on it. Tasks: 1—L, R-L, L-L, C-L. Electromechanical analogies. Mutual induction. Coefficients of mutual induction.

VII. MECHANICAL AND ELECTRICAL VIBRATIONS

1. Mechanical vibrations. The equation of small free oscillations near the position of stable equilibrium, its solution is harmonic oscillations. Amplitude, phase, period, frequency. Initial conditions. Vector addition of oscillations. Full energy. Transformation of energy. Dynamic and energetic approach to solving problems about oscillations. The amplitude of the velocity and acceleration fluctuations. Parametric resonance. A mathematical pendulum, a load on a spring, more complex systems. Attenuation of oscillations. The Q-factor of the oscillatory system.

2. Electrical vibrations. Oscillatory circuit. Free oscillations in the circuit. Transformation of energy in the circuit. Thomson's formula. EMF source in the circuit. Damping vibrations. The quality of the contour. Parametric resonance.

3. Forced fluctuations. Alternator. Active, capacitive, inductive resistances. Ohm's law for an alternating current circuit. The power in the AC circuit. The effective value of current and voltage. Resonance of voltages and currents. Calculation of AC circuits using vector diagrams. Three-phase current. Asynchronous motor. Switching the load into a three-phase network. Transformer. Transmission of electricity over long distances.

VIII. MECHANICAL WAVES.

1. Mechanical waves. The beginning of acoustics. Transverse and longitudinal waves — the elasticity of the medium for shear and compression. Kinematics of the wave. Description of the motion of a continuous medium. Harmonic waves. The wavelength. The relationship of the wavelength with the speed of its propagation and frequency. The wave number. Plane and spherical waves. Superposition of waves. Standing wave. Wave dynamics. Transfer of energy and momentum. The balance of energies in a running and standing wave. Intensity. Reflection of waves. The wave equation. The speed of the waves. Variance. Phase and group velocities. The Doppler effect. Sound waves. The speed of sound in an ideal gas. Volume and pitch. Echo. Acoustic resonance. Ultra- and infrasound. Sound generation.

2. Electromagnetic waves. Introduction of the displacement current into the law of magnetic field circulation. The complete system of Maxwell's equations. Electromagnetic waves are the solution of Maxwell's equations. The transversity of electromagnetic waves. The speed of propagation of electromagnetic waves. Its independence from the reference frame is the collapse of Galileo's transformations. The relativity of simultaneity is the beginning of the theory of relativity. Changing the running of the clock. The Lorentz transformation. Change of scale. Kinematics of SRT. Plane and spherical electromagnetic waves. Types of polarization of electromagnetic waves. The density and flow of energy in an electromagnetic wave. Reflection and refraction of electromagnetic waves. Interference of electromagnetic waves. Vector diagrams for the amplitude at a point. Dispersion of the medium. Scattering of electromagnetic waves. The scale of electromagnetic waves. The principle of radiotelephone communication. The beginnings of radio engineering: the simplest receiver and generator. Modulation and demodulation of electromagnetic waves.

IX. OPTICS

1. Physical optics. Wave propagation. The Huygens principle. Derivation of the laws of refraction and reflection of waves from the Huygens principle. Interference of waves. Maximum and minimum conditions. Temporal and spatial coherence. Interference in films. Strips of equal thickness and equal slope. Newton's rings. The Huygens—Fresnel principle. Reflection and refraction of waves. Diffraction. Fresnel zones. Zone plate. The lens. Diffraction grating. Resolution. Rayleigh criterion. Polarization of light. Brewster's corner.

2. Geometric optics. Photometry. Geometric optics is the limiting case of wave optics. Preservation of phase relations by the lens. Beam. The Fermat principle. The laws of reflection and refraction of light. Full reflection. Real and imaginary images and sources. Thin lens. Derivation of the formula of a thin lens from the law of refraction. The course of the rays in the lens. "The perfect lens." The existence of the image. Differences from the real lens. The derivation of the formula of the "ideal" lens. Newton's formula. Linear and angular magnification. Longitudinal magnification. Building images. Multi-lens systems. Optical instruments: telescope, microscope, magnifying glass, telescope. Photometry. Energy and light units. Luminous flux. The power of light. Illumination.

X. ATOMS AND QUANTA. CORE PHYSICS. ELEMENTARY PARTICLES

1. Photo effect and its regularities. Einstein's photon. The equation of the photoelectric effect. The Compton effect. Phenomena confirming the complexity of the atom. The Rutherford atom model. Spectral analysis and the difficulties of Bohr's theory. The de Broglie hypothesis and the concept of quantum mechanics.

2. The composition of the core. Isotopes. Nuclear forces. Nuclear reactions. The binding energy of the nuclei. Radioactivity. Artificial radioactivity. The law of radioactive decay. The reaction of fission and synthesis. The current state of elementary particle physics.

3.1 BASIC LITERATURE

1. Мякишев, Б.Б. Буховцев, Н. Н. Соцкий. Физика. 11 класс. Учебник. - М.: Просвещение, 2011
2. Г.Я. Мякишев, Б.Б. Буховцев, В.М. Чаругин. Физика. 10 класс. Учебник. - М.: Просвещение, 2011
3. Мякишев Г.Я., Синяков А.З. Физика: Молекулярная физика. Термодинамика. 10 кл.: Учебник для угл.изучения физики – М.; Дрофа, 2005
4. Мякишев Г.Я., Синяков А.З., Слободсков Б.А. Физика: Электродинамика 10-11 кл.: Учебник для угл.изучения физики: 3-е изд. – М.; Дрофа, 2015
5. Мякишев Г.Я., Синяков А.З. Механика. 10 кл.: Учебник для угл.изучения физики: 3-е изд. – М.; Дрофа, 2005
6. Мякишев Г.Я., Синяков А.З. Колебания и волны. 11 кл.: Учебник для угл.изучения физики: 2-е изд. – М.; Дрофа, 2015
7. Мякишев Г.Я., Синяков А.З. Оптика. Квантовая физика. 11 кл.: Учебник для угл.изучения физики. – М.; Дрофа, 2014
8. Рымкевич А.П. Сборник задач по физике 10 11 классы: 13-е изд. - М.; Дрофа, 2014

3.2 ADDITIONAL LITERATURE

1. Н.И. Гольдфарб. Физика. Задачник. 9 – 11 классы. – М.: Дрофа, 2015
2. Н.А. Парфентьева, М.В. Фомина. Правильные решения задач по физике. - М.: Мир, 2006
3. С.И Кашина, Ю.И. Сезонов. Сборник задач по физике. – М.: Высшая школа, 1996
4. О.И. Громцева Физика. Полный курс А.В.С. Самостоятельная подготовка к ЕГЭ. - М.: Экзамен, 2013
5. Тарасов, А.Н.Тарасова. Готовимся к экзамену по физике. - М.: ОНИКС, Мир и Образование, 2007
6. Белолипецкий С.Н., Еркович О.С., Казаковцева В.А., Цвецинская Т.С. Задачник по физике. – М.: ФИЗМАТЛИТ, 2005.1. Электрическая станция как основной генерирующий элемент энергосистемы. Виды электрических станций.