NATIONAL TECHNICAL UNIVERSITY OF UKRAINE
"Igor Sikorsky Kiev Polytechnic Institute"

PHYSICO-MATHEMATICAL FACULTY

APPROVED
Academic Council
Physics and Mathematics Faculty
Minutes No. _1_ of February 23, 2017
Chairman of the Academic Council _____V.V. Vanin

PROGRAM

Basic entrance exam to postgraduate study

From the specialty 104 Physics and Astronomy

The program is recommended
Educational and methodical commission
Faculty of Physics and Mathematics
Minutes No. from. .2017_

Kyiv – 2017

I. INTRODUCTION

In our time, the higher school should solve enhance the task the fundamental nature of the education of scholars. Physics is in the first series of fundamental disciplines along with mathematics, chemistry, and others.

Along with the fundamentals of education for a specialist is important the ability to effectively use the results of physical research for accelerating scientific and technological progress.

Disciplines, the content of which is included in the exam, belong to the cycle general disciplines. These are disciplines such as General Physics. Mechanics", "General Physics. Molecular Physics "," General Physics. Electricity and Magnetism "," General Physics. Optics "," General physics. Physics of the atom », "Physics of the nucleus and elementary particles". The purpose of this exam is to test the skills and abilities of entrants to determine the physical characteristics of processes, knowledge of the basic principles and laws of physics and their mathematical form, observation and experimental methods study of basic physical phenomena; Presence of boundaries application of physical models and theories.

Applicants must fully understand the fundamental laws Physics and methods of their research, be able to apply this knowledge when considering separate phenomena, to combine their physical substance with analytical ones correlations, ability to combine macroscopic phenomena with them microscopic mechanism; be able to use knowledge of general courses Physics in the study of other disciplines in the specialty.

An introductory test takes place in the form of a written exam.

Each entrant receives a ticket, which contains three theoretical questions on physics. Preparation of the response is given 90 minutes.

II. KEYWORD

The introductory test program contains the following sections:

Section 1. Mechanics.

1. Pulses of the material point and the mechanical system. Center of the masses of the mechanical system.

Features of the motion of the center of the masses of a closed mechanical system. The law of conservation impulse

2. Reactive movement. Formula Mescherskaya dependence of the rocket's speed on the mass.

3. Accelerated motion along the curve of the trajectory. Tangential and normal acceleration. Vector of angles, vector of angular velocity. Uniform circle movement (period and rotational speed, centripetal acceleration).

4. Force and its influence on material bodies. The second and third laws of Newton. Unlocked system. Dimensions of physical quantities.

5. The potential energy of the material point. Work of potential forces at

Moving the material point. The connection between the force acting on the particle, and its potential energy.

6. Kinetic energy of the material point. The law of conservation of energy is closed mechanical system. Power.

7. The boundaries of movement. Finite and other finite movements. Potential potential pit barrier. Reverse points, points of rest. Stable and unstable equilibrium.

8. Moment of the momentum of the material point and the mechanical system. The law of conservation

Moment of momentum. The moment of strength. Shoulder pulse, shoulder force.

9. Laws of conservation of momentum and moment momentum of a closed system as manifestations homogeneity and isotropy of space.
10. Properties of the gravitational field. The force of the gravitational interaction of the two material
Points Vector of gravitational field strength. Potential of gravitational field.
The tensile strength of the gravitational field near the Earth's surface.
11. The equation of motion of a rigid body. Archimedes lever rules.
12. Movement in a non-inertial system. Centripetal force, Coriolis force.
13. Elements of mechanics of liquids. Euler's Equation.
14. Hydrostatics. The laws of Archimedes and Pascal. The principle of the hydraulic press.

Section 2. Molecular Physics.

1. Perfect gas. The pressure of the ideal gas, its connection with the mean square
The velocity of the molecules.
2. Deviation of gases from the ideal. The forces of interaction between molecules are orientational, inductive, dispersive. Van der Waals equation.
3. Barometric formula and experiment of Perrena. Boltzmann's Law.
4. Distribution of molecules by components of speed. Maxwell's distribution. Most likely the velocity of the molecules. Average velocity of molecules.
5. The concept of the function of the distribution of molecules at speeds. Medium computing speed f(v) and mean square speed using the distribution function f(v).
6. The concept of reversible and irreversible processes. Expansion of the ideal gas in emptiness
7. Entropy as a function of the state of the thermodynamic system. Entropy with reversible processes in a closed system.
8. Entropy under irreversible processes in a closed system, law of growth entropy
9. The internal energy of the ideal gas. The amount of heat and its mechanical equivalent. The first law of thermodynamics.
10. Heat capacity of ideal gases (cv, cp). Equal Divorce Law. Heat capacity is one, two- and three-atom gases.
11. Mutual transformations of mechanical and thermal energy during the cyclic process. The coefficient of efficiency of the thermal machine.
12. The second law of thermodynamics. Carnot cycle. Efficiency of this cycle.
13. Refrigeration machine. The first Carnot theorem (the efficiency of the irreversible cycle is less efficiency of the Carnot cycle). The second Carnot theorem (the efficiency of the Carnot machine does not depend on the genus working body).
14. Physical content of entropy, entropy and probability. Entropy and mess. The third law thermodynamics
15. Osmotic pressure, Van Gofe's law (the role of osmosis in living organisms and plants).
16. Adiabatic process, state equation.
17. Liquids - superficial forces, equilibrium conditions at the interface of two media, Edge angle
18. Transfer phenomena-the average number of collisions per unit time and the length of the free mileage of the molecule. The concept of an effective particle cross section.
19. Stationary diffusion in gases, calculation of the diffusion coefficient.

Section 3. Electricity and Magnetism.

1. The principle of superposition for an electric field.
2. Potential, electric field strength, tensile measurement unit electric field.
3. Gauss theorem for an electric field in vacuum (integral and differential forms).
4. Potential and potential difference. The potential nature of the electric field.
5. Connection of the potential of the electric field with electric field strength E.
6. Coulomb law.
7. Conductors in the electric field. Capacity of the conductor. Boundary conditions on the surface conductor
8. Electromotive Force (EPC). Units of measurement of EMF.
9. DC. Strength and current density. Law of conservation of charge and equation continuity
10. Kirchhoff's rules.
11. The Law of Bio-Savar-Laplace.
12. Theorem on the circulation of a magnetic field (integral and differential forms).
13. Linear magnetic media (dia-paramagnetics). Magnetic susceptibility and magnetic permeability M.
14. The moment of strength M, acting on a circuit with a current in a magnetic field by induction.
15. Magnetic Flux. Coefficients of self-induction and interinduction. Inductance toroidal coil.
16. Electromagnetic induction. Lenz rule for induction current direction.
17. Boundary conditions for an electrostatic field at the boundary of two dielectrics. Material equations.
18. Maxwell's system of equations in an integral and differential form. Physical content of the Maxwell equations.
19. Wave Equation. Flat electromagnetic waves in a homogeneous medium. Spreading speed.
20. Energy of the electromagnetic field. Flow of energy. Ponying vector. Pressure radiation. Pulse of the electromagnetic field.

Section 4. Optics.

1. Wave nature of light. Equation of an electromagnetic wave. Properties and electromagnetic wave parameters. Light intensity.
2. Monochromatic waves. Energy carried by the electromagnetic wave.
3. Photometry. Basic concepts and units of measurement (the stream of radiation energy, light intensity, illumination, brightness and brightness of the source). Lambert sources.
4. The notion of coherence. Front of the wave. Interference of electromagnetic waves. Equation for the intensity and conditions of the minima and interference maxima paintings
5. Width of the interference band. Classical interference schemes (Young's research, Lloyd's mirror, Fresnel biprism, Biennale Fight, Michelson interferometer, Fabri-Perot Interferometer).
6. Principle Huygens-Fresnel. Fresnel zone method. Zone record.
7. Diffraction of electromagnetic waves. Types of diffraction. Fraunhofer diffraction from Cracks Diffraction pattern. Minimum and Maximum Conditions.
8. Light intensity in the diffraction pattern from the slit.
9. Diffraction grating. Light intensity in the diffraction pattern from the grid. Kind Diffraction pattern. Minimum and Maximum Conditions.

10. The notion of holography. Holography of a plane wave. Fresnel holograms
11. Polarization of light. Degree of polarization. Natural light. Types of polarization.
12. Reflection and refraction on the boundary between two dielectrics. Formula Fresnel.
13. Consequences of the Fresnel formulas. Brewster angle. Malusa's Law.
14. Rotation of the plane of polarization. Natural rotation. Faraday's Effect. Theory rotation.
15. The phenomenon of double refraction. Normal and unusual waves. Polarization With double refraction. Dichroism
16. Dispersion of light.
17. Relationship between phase and group velocities. Absorption of light. Law of Bouguer.

Section 5. Physics of the atom.

1. Thermal radiation. The law of Stefan-Boltzmann. Kirchhoff equation. Formula Planck for the radiating ability of an absolutely black body. Plank's hypothesis For thermal radiation.
2. Corpuscular nature of light. External photoelectric effect. Equation of Einstein. The red border of the photoelectric effect. Brake X-ray radiation.
3. Corpuscular nature of light. Compton's effect. Experiments and obtaining the equation.
4. Nuclear model of atom (Rutherford atom). Rutherford Experiments. Scattering section.
5. The spectrum of the hydrogen atom. Spectral series. Generalized Balmer's formula. Postulates of Bohr
6. Bohr's theory for the hydrogen atom.
7. Wave properties of particles. De Broglie hypothesis Experiments to confirm Wave properties of elementary particles. Statistical interpretation of the wave De Broglie
8. Wave properties of particles. Heisenberg uncertainty relation (Coordinate-pulse, energy-time). Their experimental confirmation.
9. The stationary and time equation of Schrödinger.
10. Consequences of the solutions of the Schrödinger equation for a hydrogen atom. Quantization moment of momentum. Orbital and magnetic quantum numbers. Degeneracy energy levels of the atom.
11. Magnetism of atoms. Experimental determination of magnetic and orbital moments of the atom.
12. Spin electron. Stern-Gerlach's experiments. Magneto-mechanical effects.
13. The principle of identity of identical particles. Pauli's principle.
14. Spin-orbital interaction. Fine structure of spectral terms.
15. Russell-saunder communication. Hund's rules Periodic system of chemical elements.

Section 6. Physics of the nucleus and elementary particles.

1. Composition of atomic nuclei, stable and unstable atomic nuclei. Isotopes, isobars and Isotones Segrech diagram.
2. Radius of the atomic nucleus and experiments on the study of the radius of the atomic nucleus.
3. The energy of the connection of the atomic nucleus, the defect of the mass of the nucleus, the excess (decree) of the mass Kernels
4. Spin atomic nuclei. Nuclear Magneton. Magnetic moments of atomic nuclei in depending on the number of nucleons in the nucleus, Schmidt hypothesis.
5. The law of radioactive decay. Became a radioactive decay. Types of radioactive collapse, conservation laws for radioactive decay.
6. Average life span of a radioactive nucleus. Half-life.
7. Alpha decay and conditions for its occurrence as a consequence of the laws of conservation of energy and impulse
8. Beta decay, types of beta decay. Application of Weizzeker's formula for explanation lines of stability.
9. Gamma-disintegration and internal conversion of electrons, peculiarities of atomic transition cores from the excited state to the main one.
10. Types of nuclear reactions, their characteristics: effective cross-section of the reaction, density flow, probability of reaction, reaction yield.
11. Nuclear reaction energy, exothermic and endothermic reaction.
12. Nuclear reaction with the formation of a composite core. Energy threshold reaction, scheme reaction
13. Thermonuclear reactions, the problem of controlled thermonuclear fusion.
14. Features of nuclear forces. The simplest atomic nucleus is deuteron.
15. Structure of a nucleon: a model of a proton and a neutron, their magnetic moments.
16. Stable and unstable elementary particles. Characteristics of the elementary particles, particle classification.
17. Types of quarks, quark model of hadron.

III. FINAL PROVISIONS

1. Support materials.
The exams do not allow the use of additional literature.
2. Evaluation criteria.
Examination ticket consists of three theoretical questions in physics.
The assessment system evaluates the ability of the entrant:
- generalize the knowledge acquired to solve specific problems, problems;
- apply rules, methods, principles, laws in specific situations;
- analyze and evaluate the facts, events and make substantiated conclusions;
- interpret circuits, graphs, diagrams;
- to present the material logically, consistently, in accordance with the requirements of the standards

The answer for an entrant is estimated on a 100-point scale (33-34 points for each question). The correct answer is a complete and adequate coverage of the issue
According to the Supplemental Entrance Testing Program.

After that, the transfer of these marks into ECTS assessment according to the table is carried out:

Amount of points scored	Score
95…100	A
85…94	B
75…84	C
65…74	D
60…64	E
Less 60	F