Federal State Autonomous Educational Institution of Higher Education
«Peoples' Friendship University of Russia»

Medical Institute

Recommended MCSD

SYLLABUS
(STUDY GUIDE)

Subject

Physics

Recommended for the direction of training (specialty)

31.05.01 General Medicine

Program (profile, specialization)

General Medicine

1.Purpose and objectives of the discipline.

Purpose:

laying the foundations of natural science thinking. Learn the basic laws of physics. Develop the ability to use physical abstractions and models when considering problems and take into account the conditions of applicability of the assumptions made at the same time. To form the skill of quantitative assessment of the accuracy of scientific prediction and the results of experiments.

Tasks:

- to form at students of a basis of materialistic Outlook on the world around, to explain to them an essence of physical laws on the example of the manifestation of these laws in well-known natural phenomena, to train in the basic techniques of measurement of physical quantities and processing of results of measurements;
- to lay a systematic approach to the analysis of information based on the search for solutions using theoretical knowledge and practical skills of the natural science cycle in order to improve professional activity.

2. Requirements for the results of the discipline:

The process of studying the discipline is aimed at the formation of the following competencies: UC-1, GPC-8, GPC-13.

The student must own:

2.1. *The universal competences which a graduate is to form when mastering an educational programmer and the achievement indicators include:*

UC-1. Being able to implement critical analysis of problem situations based on systems approach, develop an action strategy;

UC-1.1. Analyzing the problem situation as a system identifying its components and links between them.

UC-1.2. Defining gaps in the information required to deal with a problem situation and designing processes to address them;

UC-1.3. Assessing in a critical way the reliability of information sources; working with contradictory information from different sources;

UC-1.4. Developing and giving meaningful reasons for and against a strategy for solving a problem situation in terms of a systematic and interdisciplinary approaches;

UC-1.5. Using logical and methodological tools for critical assessment of the modern concepts of a philosophical and social nature in the relevant field of study.

2.2. *General professional competences which a graduate is to form when mastering an educational programmer and the achievement indicators include:*

GPC-8. Being able to use main physical and chemical, mathematic and scientific notions and methods when dealing with professional tasks;

UC-8.1. Analyzing the factors of harmful impact on the vital functions of the elements of the environment (technical means, technological processes, materials, buildings and structures, natural and social phenomena) ;

UC-8.2. Identifying hazardous and harmful factors within the framework of the carried out activities;

UC-8.3. Solving problems related to unsafe behavior and participating in activities to prevent emergencies in the workplace;

UC-8.4. Observing and explaining the rules of behavior in case of emergencies of natural and man-made origin; providing first aid; participating in recovery activities;

GPC-13. Being able to understand the operation principles of modern IT and use them to solve the professional tasks;

GPC-13.1. Using information technology in professional activity and observing the information security rules. Information and communication media and technology in professional activity;

GPC-13.2. Observing the information security rules in professional activity.

Know:

- Safety rules when working with devices and installations in physical research and biological laboratories;
- Scientific explanation of basic natural phenomena and regularities of their occurrence and consequences;
- The law of universal gravitation and the laws of classical mechanics of Newton;
- Features of aggregate States of substances and properties of materials in these States;
- Molecular-kinetic theory of the structure of matter. Basic concepts and laws of the theory of gases and thermodynamics. The principle of operation of the heat engine and refrigerator.
- Nature, living conditions and human exposure to direct and alternating current. Electrical Equipment Regulations.
- The principle of operation of electric motors of direct and alternating current.
- The nature of electromagnetic radiation, the mechanism of its generation, types and features of electromagnetic waves.
- The nature of light, its properties and the mechanism of interaction with matter.
- The structure of the atom and its nucleus. Principles of release of nuclear energy.
- Rules for the use of sources of ionizing radiation and the risks associated with their effects on living organisms; methods of protection and dose reduction of radiation exposure in humans

Be able to:

- Use educational, scientific, popular science, reference books;
- To operate the instrumentation;
- Perform statistical processing of experimental data;
- Interpret natural phenomena from a natural science point of view.;
- To use sources of direct and alternating current.;
- Prevent short circuits in electrical circuits and use electrical overload protection devices; Operate powerful sources of light radiation and lasers; Protect against ionizing radiation.

Own*:*

1. Methods of application of physical laws in the analysis of specific natural phenomena;
2. Methods of collecting scientific information, preparation of reviews, abstracts and reports, analysis of information on research objects;
3. Skills of using electronic and optical devices in measuring procedures;

4. Knowledge of safety at work with electrical equipment and sources of ionizing radiation;
5. Methods of processing measurement results and calculations.

3The volume of disciplines and types of academic work

The total complexity of the discipline is 2 credits.

Вид учебной работы	Всего часов	Семестры			
Аудиторные занятия (всего)	54 часа		2		
В том числе:					
Лекции	18 часов				
Лабораторные работы (ЛР)	32 часа				
Контрольные работы	4 часа				
Самостоятельная работа (всего)	18 часов				
Общая трудоемкость час	72 часа				
зач. ед.	2,0				

№ р/р	Type of educational work	Total hours	Semesters			
			1			
1.	**Classroom activities (total)**	48	48			
	Including:	-	-	-	-	-
1.1.	Lectures	16	16			
1.2.	Other classes	-				

	including:					
1.2.1.	*Practical class (PC)*	-	-			
1.2.2.	*Seminars (S)*	-	-			
1.2.3.	*Laboratory work (LW)*	22	22			
1.2.4	*Test (T)*	10	10			
	Of them in an interactive form (IF):	-	-			
2.	**Independent work (total)**	24	24			
	Including:	-	-	-	-	-
2.1.	Course project (work)	-				
2.2.	Settlement and graphic works	14	14			
2.3.	Paper					
2.4.	Preparation and passing of interim certification (preparation for written surveys)	10	10			
	Other types of independent work					
3.	**Total complexity (ac.hours)**	72	72			
	Total complexity (credit units)	2	2			

4. Content of the discipline

4.1. The content of the discipline

№ p/p	Name of discipline section	Content section
1	**Introductory lecture. Fundamentals of vector and mathematical analysis**	Methods of processing of measurement results. Direct and indirect measurements. Theory of errors. Types of errors: gross, systematic, random; absolute, relative. Rules for registration of laboratory work. The order of writing the abstract. Safety at work in the physical laboratory. Basic concepts of mathematical and vector analysis. Derivatives and differentials. Rules for adding (subtracting) and multiplying vectors. Integration rules. Calculations of indefinite and definite integrals.
2	**Mechanics. Dynamics, mechanical oscillations**	Introduction. Definitions (kinematics, dynamics, statics, trajectory, reference systems, equation of motion). Rectilinear motion. Circular motion. Inertia. Force of inertia. Dynamics of rotational motion. Moment of inertia. The moment of impulse and the law of its preservation. Gravitational interaction. Acceleration of gravity. Weightlessness. Harmonic vibrations. Gravitational interaction. Acceleration of gravity.

		Work and energy. Potential field, the work of conservative forces, potential energy. Kinetic energy. The law of conservation of energy. Rotational motion of a rigid body. A moment of strength. The basic equation of the dynamics of rotational motion. The equation of motion of the angular momentum. The law of conservation of the angular momentum.
3	**The waves. Sound wave**	Mechanical waves. The plane wave equation. Parameters of vibrations and waves. Energy characteristics. The Doppler effect and its use in medicine. Sound. Types of sounds. A complex tone and its acoustic spectrum. Wave resistance. Objective(physical)and subjective (biological) characteristics of sound. Infrasound. Ultrasound, the physical basis of application in medicine.
4	**Hydrostatic. Molecular Physics**	The viscosity. Methods for determining the viscosity of liquids. Stationary flow, laminar and turbulent flows. Newton's formula, Newtonian and non-Newtonian liquids. The Poiseuille formula. The Reynolds number. Features of hemodynamics in the main, resistive, capillary and venous vessels of the circulatory model. Work and warmth. The first beginning of thermodynamics. Heat capacity. An adiabatic process (Poisson's formula). The basic equation of molecular kinetic theory. The heat and motion of molecules. The first principle of thermodynamics applied to the human body. The role of nutrition and respiration. Internal energy. Internal pressure and surface tension in the fluid. Diffusion. Osmosis. Wetting Capillary phenomena.
5	**Electricity and magnetism**	Electric charges and their properties. Coulomb's law. The electrostatic field. Field strength. Power lines. Potential. Equipotential surfaces. The relationship between tension and potential. Conductors in an electrostatic field. Electrical capacity. Capacitors, their connection. The energy of the electric field. Current strength and current density. Electromotive force (EMF.). of the EMF source. Ohm's law for a homogeneous, inhomogeneous section of the circuit, for a closed circuit. The Kirchhoff rules. Ohm's laws and Kirchhoff's rules for direct current. Electric and magnetic fields, currents and electromagnetic fields. The total resistance (impedance) in electrical circuits. Ohm's law for alternating current and voltage. Diathermy. UHF therapy. Microwave therapy. Physical foundations of rheography and its application in medicine.
6	**Optics**	Geometric optics. The phenomenon of total internal reflection of light. Refractometry. Fiber optics. The eye is an optical system. Microscopy. Wave optics. Electromagnetic waves. The scale of electromagnetic waves. Energy characteristics of light fluxes: the flux of light radiation and the flux density (intensity). Diffraction grating. The resolution of optical devices and the eye. The polarization of light. Polarization microscopy. Polarimetry.

		The interaction of light with matter. Light scattering. Light absorption. The Booger-Lambert-Behr law.
7	**Electromagnetic radiation of the optical range**	Thermal radiation. Characteristics and laws of thermal radiation. The spectrum of black body radiation. The radiation of the Sun. Application of Kirchhoff's law for measuring brightness temperature.Calculation of the radiation temperature based on the Stefan-Boltzmann law. Lasers and their application.
8	**Atomic structure. EPR. NMR. Ionizing radiation.**	Atomic structure. Nuclear force. Isotopes. Electronic paramagnetic resonance. Nuclear magnetic resonance. Principles of magnetic resonance imaging. Electron-positron tomography. Ultraviolet radiation and its application. X-ray radiation and its use in land management. Radioactive radiation. Detection and dosimetry of ionizing radiation

Sections of disciplines and types of classes

№ p/p	Section Name	Lectures	Examinations and laboratory work			SIW	Total
			T	LW	of them in IF		
1.	Introductory lecture	2		2		2	6
2.	Mechanics. Dynamics, mechanical oscillations.	2	2	6		3	13
3.	The waves. Sound wave	2		2		2	6
4.	Hydrostatic. Molecular Physics	2	2	2		2	8
5.	Application of electric current and electric and magnetic fields.	2	1	4		6	13
6.	Optics	2	2	4		2	10
7.	Electromagnetic radiation.	2	1	1		3	7
8.	Ionizing radiation. The structure of the atom. ESR. NMR	2	2	1		4	9

4.2. Laboratory works

№ p/p	№ discipline section	Subjects of laboratory classes and seminars	Labor intensity (час.)
1.	**1**	Methods of processing measurement results. Direct and indirect measurements. Theory of errors. Types of errors: gross, systematic, random; absolute, relative. Rules for registration of laboratory work. The order of writing notes. Determination of gravitational acceleration using the mathematical pendulum model	2
2.	**2**	The study of the spectral sensitivity of the ear at the threshold of hearing	2
3.	**2**	The study of the method of ultrasound echolocation using a medical ultrasound	2
4.	**2**	Test on the theme of «Oscillations and waves»	2
5.	**3**	Determination of dynamic viscosity by Stokes method	2
6.	**3**	Determination of the ratio of the specific heat of air at constant pressure to its specific heat at constant volume	2
7.	**3**	Test on the subject of «Surface phenomena in a liquid»	2
8.	**4**	Study of DC and AC circuits	2
9.	**4**	Physical principles of electrocardiography	2
10.	**5**	Test on the theme of «electric current and electromagnet fields in medicine. Bioelectric potential»	2
11	**6**	Determination of the wavelength of a helium-neon laser by diffraction	2
12	**6**	Determination of lens focal length and microscope magnification	2
13	**7**	Test on the subject of «wave and geometric optics»	2

14	**7**	Concentration colorimetry	2
15	**8**	X-ray properties	2
16	**7,8**	Test on the subject of «structure of the atom. types of radiation»	2

5. Educational, methodical and informational support of the discipline: a) **Main literature**

1. Samuel. J Ling, Jeff Sanny, William Moebs (2016), "**University Physics Vol 1**", Openstax, Rice University, .
2. Samuel. J Ling, Jeff Sanny, William Moebs (2016), "**University Physics Vol 2**", Openstax, Rice University, .
3. Radj Kumar, G.L. Mittal (1997), "Physics", Nageen Prakasham, Meerut.
4. Tom Duncan, Heather Kennett, (2014) "**Cambridge IGCSE Physics Third Edition**", Hodder Education, an Hachette UK Company.
5. Ahmed Mohammed (2008),"**Physics for Medical Students**", Wheatmark, 610 East Delano Street, suite 104, Tucsun, Arisona 85705 U.S.A.

b) **Additional Literature**

1. V.M. Yavorsky, A.A. Pinsky. Fundamentals of Physics. -M .: Nauka, 2007.V..
2. N.I. Golovtsov, I.M. Kashirsky, A.P. Loginov, N.A. Kovalchukov, A.K. Nikitin, T.A. Ryzhov. Tasks in physics. –M.: Publishing house of RUDN University, 2008. -159c.2.
3. Konev S.V., Volotovsky I.D. Photobiology // Minsk: BSU, 1974 - 285 p.
4. Nerpin S.V., Chudnovsky A.F. Energy and mass transfer in the system "plant-soil-air" // L .: Hydrometeoizdat, 1975. - 358 s.
5. Vladimirov Yu.A. and others. Biophysics // M .: Medicine, 1991 - 427 c.

c) **software:** OC MS Windows (XP и выше), MS Office 2010, Mentor, TUIS.

d) **databases, reference and retrieval systems**

1. «Soros Educational Journal» - http://www . issep . rssi .ru
2. Project "Ramler-science" - natural sciences - http://www . nature .ru 3. Electronic version of the journal "Science" - http://www . sciencemag .org

6. Material and technical support of the discipline:

RUDN University classroom Fund, including classrooms equipped with projectors and computers; electronic resources of RUDN University, including for computer testing; educational literature.

7. Guidelines for organizing the study of discipline

Discipline study conducted using demonstration materials and laboratory facilities.

Each section includes:

- overview and orientation lectures (1 hour);
- laboratory workshop (2 hours).

Knowledge control is implemented on a point-rating system using a 100 point scale:

10 frontal laboratory work - written reports are evaluated by 5 points maximum for each work (in total - maximum 50 points);

5 individual written tests - estimated at 10 points each maximum (50 points in total);

8. Organizational and methodological structure of the course

The course consists of lectures, laboratory work. Lectures are held using demonstrations and other illustrative material.

During the semester 5 tests, 10 laboratory works are carried out. The list of questions submitted for tests is issued to students and posted on the training portal 2 weeks prior to the test. Specific questions (options) to be answered by students are determined on the day of certification. The student must write tests independently, without using additional literature, mobile phone, electronic devices. The time of writing examinations is 1 hour. The second test is written until the middle of the semester (intermediate certification), the third and fourth - at the end of the semester. Upon completion of the course summarizes the performance.

9. Tasks for independent work on topics

1. Oscillations and waves. Additional material submitted to the laboratory workshop: Characteristics of sound. Tasks solved by the body's hearing aid. Ear and sound passing through it. Sound identification by the basilar membrane and the organ of Corti. Vestibular apparatus. Binaural effect. Audiogram. Weber – Fechner law. Generation and reception of ultrasound using the piezoelectric effect. The attenuation of ultrasound in the environment. The reflection of ultrasound at the boundary n. Ultrasound echolocation and tomography. The use of ultrasound in agronomy and other branches of science and technology.

2. Surface phenomena in fluid. Additional material submitted to the laboratory workshop: Liquid state of matter. Perfect fluid. Hydrodynamics. Equation of continuity of the jet. Bernoulli equation. Fluid flow at the site of narrowing of the channel (cholesterol plaques). Viscous fluid. Newtonian and non-Newtonian fluids. Newton's formula. Poiseuille formula. Channel hydraulic resistance. Types of fluid flow. Reynolds number. Hemodynamics. Continuity of blood flow. Methods for determining the viscosity of a liquid (overview). Stokes methods (derivation of the calculation formula).

3. The use of electric current and electromagnetic field. Additional material submitted to the laboratory workshop: Electric current, conditions of occurrence. Current strength The rate of thermal and directional movement of particles. Resistance - physical meaning and temperature dependence (in metals). Emf. Ohm’s law for a complete chain. Work and power current. Joule's Law - Lenz. The phenomenon of electromagnetic induction. Faraday law and the rule of Lenz. Self-induction. Generating AC. Active, capacitive and inductive load in an alternating current circuit. Physical basis of electrocardiography.

4. Wave and geometric optics. Types of radiation. Additional material submitted to the laboratory workshop: The laws of reflection and refraction of light. Full internal reflection

(phenomenon and application). Lens Enlightenment. Microscope (magnification, resolution). Interference and diffraction of light. Diffraction of light on the slit. Fresnel zones. The resolution of optical devices. Electron microscope. Absorption of light by matter. Booger law. Absolutely black body (act). The laws of radiation (act). Types of spectra. Spectral analysis of the substance.

10. Glossary of basic terms and definitions studied in the discipline "Physics"

Aggregate states of matter	The aggregate state of a substance is the state of the same substance in different temperature and pressure ranges. The main aggregative states of a substance are considered gaseous, liquid and solid states, transitions between which are usually accompanied by abrupt changes in density, entropy and other physical properties. The fourth aggregate state of a substance is plasma.
Acoustic oscillations	Elastic vibrations of the medium with acoustic frequencies
Amorphous bodies	Amorphous bodies are solids, which are characterized by a disordered arrangement of particles in space.
Amplitude	The amplitude of oscillations is the largest deviation of an oscillating body from its equilibrium position.
Atmosphere pressure	Atmospheric pressure - the pressure of atmospheric air on the objects in it and on the earth's surface. At each point of the atmosphere, atmospheric pressure is equal to the weight of the overlying air column with a base equal to a unit of area; atmospheric pressure decreases with altitude.
Atom	An atom is the smallest part of a chemical element, possessing its properties and capable of independent existence.
Atomic nucleus	The atomic nucleus is a positively charged central part of an atom, having a volume in which its main mass is concentrated. The atomic nucleus consists of protons and neutrons. The number of protons determines the charge of the atomic nucleus
Bioelectric potentials	Bioelectric potentials - electrical potentials in tissues and cells of living organisms
Brownian motion	Brownian motion is a random movement of small particles suspended in a liquid or gas that occurs under the action of the impacts of environmental molecules.

Weight	Weight is the force with which anybody due to the attraction of the Earth acts on a support or suspension.
Interaction in physics	Interaction in physics is the effect of bodies or particles on each other, leading to a change in their movement.
Viscometer	A viscometer is a device designed to measure viscosity or internal friction of liquids and gases.
Air humidity	Air humidity is the content of water vapor in the air.
Internal energy of the body	The internal energy of the body is the energy of motion and interaction of the particles that make up the body. The internal energy of the body does not depend on the position of the body relative to other bodies and the speed of movement of the body. The internal energy of the body can manifest itself in the form of heat or in the form of work done by the body.
Viscosity (Internal Friction)	Viscosity is the property of liquids and gases to resist the movement of one part relative to another. Viscosity is due to the occurrence of internal friction between particles during the movement. The forces of internal friction are directed along the surface of the contacting layers and depend on their relative velocities.
Hydrostatics	Hydrostatics (from the Greek. Hydor-water and statos - standing) - one of the subsections of mechanics, which studies the equilibrium of a liquid, as

	well as the equilibrium of solids, partially or completely immersed in a liquid.
Sound volume	The loudness of the sound is the subjective quality of the auditory sensation, which allows you to place sounds on a scale from low to high.
Pressure.	Pressure is a physical quantity equal to the ratio of the force acting perpendicular to the surface to the area of this surface
Motion	Motion is a form of existence of matter; the way of being of material objects, consisting in their changes and interconversions. The main forms of movement are: mechanical, physical: thermal, electromagnetic, gravitational, atomic and nuclear; chemical, biological. A common measure of various forms of motion is energy.
Dynamics	Dynamics (from the Greek. Dynamikos - force) - a section of mechanics devoted to the study of the movement of material bodies under the action of forces applied to them.
Wave diffraction	Diffraction of waves (from the Latin. Diffractus - broken) - a deviation from the laws of geometric optics, reflected in the light bending around small obstacles. Diffraction is observed when light propagates in a medium with pronounced inhomogeneities; it is manifested especially clearly in cases when the size of the obstacles is less than the wavelength or comparable to it
Dielectric	A dielectric is a substance with low electrical conductivity.
Liquid	Liquid - a substance in a state intermediate between solid and gaseous. This is an aggregate state of matter in which the molecules (or atoms) are interconnected so much that it allows it to maintain its volume, but not strong enough to retain its shape. Fluids easily change their shape while maintaining volume. The surface of the liquid that is not in contact with the walls of the vessel is called the free surface. It is formed as a result of gravity on the fluid molecules.
Charged particles	Charged particles are positively or negatively charged particles of a substance that are not connected into a single electrically neutral system. In metals, free charged particles (current carriers) are conduction electrons, ions in electrolytes, electrons and holes in semiconductors.
Sound	A sound (sound waves) is an oscillatory motion of particles of an elastic medium propagating in the form of waves: gaseous, liquid or solid. The word “sound” also refers to sensations caused by the action of sound waves on a special sense organ (organ of hearing or, more simply, ear) of a person

	and animals: a person hears a sound with a frequency from 16 Hz to 20 kHz. Frequencies of this range are called sound.
Body impulse	The impulse of a body is a quantity equal to the product of the mass of the body and its speed. It should be remembered that this is a body that can be represented as a material point. The body impulse (p) is also called the amount of movement. The concept of the amount of motion was introduced into physics by René Descartes (1596-1650). The term "impulse" appeared later (impulses in Latin means "push").
Inertial reference system	An inertial reference system is a reference system in which the law of inertia is valid: a material point, when no forces act on it (or there are forces that are mutually balanced), is at rest or uniform rectilinear motion

Wave interference	Interference of waves (from lat. Inter - mutually, between themselves and ferio - strike, strike) - mutual amplification or weakening of two (or more) coherent waves when they are superimposed on each other and simultaneously propagating in space, depending on their path difference
Evaporation	Evaporation is the transition of a substance from a liquid to a gaseous state (vapor) that occurs from the free surface of a liquid at any temperature.
Emitted particles	Emitted particles are particles emitted during a nuclear or any other similar reaction. Examples of particles emitted are alpha, beta and gamma particles.
Kinematics	Kinematics is the study of the geometric properties of the motion of bodies.
Boiling	Boiling is an intense transition of liquid to vapor, which occurs with the formation of vapor bubbles throughout the entire volume of liquid at a certain temperature.
Oscillations	Oscillations are an iterative process of changing over time the value of a physical quantity around its average value. Oscillations are characterized by amplitude, period, frequency and phase. There are non-periodic, periodic and harmonic oscillations. Depending on the physical nature distinguish mechanical, electromagnetic and other vibrations. Oscillations are a very common type of movement.
Capacitor	A capacitor is a system of two or more charged conductors with equal-value charges separated by a dielectric layer.
Condensation	Condensation (from the Latin. Condensatio - compaction, condensation) - the transition of a substance from a gaseous state (vapor) to a liquid or solid state.
Circulatory system	Circulatory system - a set of circulating fluid (blood), the network of blood vessels, contractile organ (heart) and blood-forming organs. In humans, the circulatory system is closed
Laser (Optical Quantum Generator)	A laser is a quantum generator emitting coherent electromagnetic waves due to stimulated emission of an active medium located in an optical resonator. Depending on the type of active medium, gas, solid-state and liquid lasers are distinguished.
Manometer	Pressure gauge - a device designed to measure the pressure or pressure difference of liquids and gases.
Body mass	Body mass is a fundamental physical quantity characterizing its inertial and gravitational properties. Measure of inertness.
Mechanics	Mechanics is the science of the mechanical movement of material bodies and the interactions between them that occur in the process.
Mechanical movement	Mechanical movement - change over time: - the position of one body relative to another; or - the position of the body parts relative to each other.
Molecules	Molecules - the smallest stable particle of a substance, consisting of atoms of one or several chemical elements, preserving the basic chemical properties of this substance.

Molecular physics	Molecular physics describes the structure of matter using molecular kinetic theory. According to the molecular kinetic theory (MKT), all bodies consist of separate particles — molecules and atoms, that is, they are not solid.

Mol	Mole is the amount of a substance whose mass, expressed in grams, is numerically equal to the relative atomic (molecular) mass. Mole - a unit amount of a substance in SI
Monocrystal	A single crystal is a solid body whose particles form a single crystal lattice (single crystal)
Power	Power is a physical quantity measured by the ratio of work to the time during which it is produced.
Moving in Mechanics	Movement in mechanics is a vector connecting the positions of a moving point at the beginning and at the end of a certain period of time.
Oscillation period	The period of oscillations is the smallest period of time after which the system making oscillations returns to the same state in which it was at the initial moment of time chosen arbitrarily.
Swimming bodies	Swimming bodies – the state of equilibrium of a solid body, partially or completely immersed in a liquid (or gas).
Plane wave	A plane wave is a wave whose direction of propagation is the same at all points in space.
Substance density	The density of a substance is a physical quantity that indicates what is equal to the mass per unit volume of this substance.
Positron	Positron - antiparticle with respect to the electron.
Surface phenomena	Surface phenomena - a set of phenomena due to the fact that the forces of interaction between the particles that make up the body are not compensated for on its surface. Surface phenomena include: surface tension, capillary phenomena, surface activity, wetting, adsorption, adhesion, etc.
Semiconductors	Semiconductors are substances whose electrical conductivity is lower than that of metals and greater than that of dielectrics and increases when heated.
Avogadro's Number	The Avogadro constant (Avogadro number) is the number of atoms (molecules, or other structural elements of a substance) contained in 1 mole. Avogadro's constant is one of the fundamental physical constants.
Forward movement	Translational motion is the motion of a rigid body, in which the straight line connecting any two points of the body moves parallel to its initial direction.
Electric field potential	The potential of the electric field is the energy characteristic of the electric field; scalar quantity equal to the ratio of the potential energy of a charge in a field to the magnitude of that charge. In SI, the potential of the electric field is measured in volts.
Fluid flow	Fluid flow - as a phenomenon - the movement of a mass of fluid bounded by a system of surfaces of solids and / or surfaces of contact between liquid and gaseous bodies.
Work force	The work of a force is a measure of the action of a force, depending on its modulus and direction, proportional to the displacement of the point of application of force.
Radius vector	The radius vector is a vector that connects the origin with the position of the point at an arbitrary point in time.
X-rays	X-rays are electromagnetic waves whose photon energy lies on the energy scale between ultraviolet radiation and gamma radiation, which corresponds to wavelengths from 10^{-14} to 10^{-8} m. The energy ranges of x-rays and gamma radiation overlap in a wide energy range..
Free fall	Free fall is the motion of a body due to the attraction of the Earth, in the absence of an initial velocity and resistance of the medium.

Heart	The heart is a hollow muscular organ divided into four cavities, located in the pericardial bag in the left half of the chest, and performing the function

	of a pump in the circulatory system.
Power in mechanics	Force in mechanics is a quantity that is a measure of the interaction of bodies.
Resting friction force	The force of static friction is a force that prevents the emergence of a slip of one body relative to another.
Speed	Speed characterizes the speed with which any changes occur in the world around us (the movement of matter in space and time).
Speed of movement	The speed of movement is the kinematic characteristic of a material point; a vector whose modulus is equal to the limit of the ratio of the displacement of a point to an infinitely small time interval, for which this movement occurred and directed tangentially to the trajectory of the body.
Offset	Offset - the deviation of the oscillating point from the equilibrium position.
State of weightlessness	The state of weightlessness is a state in which the material body is located, freely moving in the field of the Earth (or another celestial body) under the action of only the forces of aggression. A distinctive feature of this state is the absence of pressure on the whole body as a whole, and on its separate parts.
Spectroscopy	Spectroscopy is a branch of physics that studies the spectra of electromagnetic radiation in order to identify information about the structure and properties of matter. The methods of spectroscopy investigate: the energy levels of atoms, molecules and the macroscopic systems formed from them; as well as quantum transitions between energy levels
Statics	Statics (from the Greek. Statos –state) is a section of mechanics in which the conditions of equilibrium of material bodies under the influence of forces are studied.
Body of reference	The body of reference is the body relative to which the change in the position of other bodies in space is considered.
Timbre	Timbre - sound quality, determined by the composition of overtones (their frequencies and amplitudes, the nature of the increase in amplitudes at the beginning of the sound and their decline at the end of the sound). For example, the timbre can distinguish the sounds of a piano and a violin at the same pitch (i.e., the same pitch frequency), but different sets of overtones.
Temperature	Temperature is one of the parameters of the state that determines the thermal state of the body, the degree of its warmth. The temperature is measured with a thermometer. In SI, temperature is measured in kelvins (K), called the thermodynamic or absolute temperature and is denoted by T. In practice, the international practical temperature scale is widely used, where the temperature is measured in degrees Celsius (C) and denoted by t °. These temperatures are related by the formula $T = t° + 273$
Thermal effect of electric current	The thermal effect of an electric current is the ability of the electric current passing through the wires to heat these wires. The thermal effect of electric current obeys the Joule-Lenz law.
Heat capacity	Heat capacity is the amount of heat absorbed by the body when heated by 1 degree.

Heat exchange	Heat transfer is a spontaneous (i.e., performed without coercion) process of heat transfer that occurs between bodies with different temperatures.
Heat transfer	Heat transfer is a way to change the internal energy of the body without doing work. Heat transfer, or heat transfer, can be done in three ways: heat conduction, convection and radiation.
Thermal conductivity	Heat conduction is a type of heat transfer in which the direct transfer of energy from particles (molecules, atoms) of the more heated part of the body to the particles of its less heated part occurs.
Thermodynamics	Thermodynamics is a branch of physics that studies thermal phenomena

	without attracting molecular kinetic representations. Thermal phenomena are studied in molecular physics and thermodynamics.
Thermometer	Thermometer - a device for measuring the temperature of air, body, soil, water, etc. during thermal contact between the object of measurement and the sensitive element of the thermometer. Thermometers are used in meteorology, medicine, hydrology and other sciences and branches of the economy.
Point material	The material point is a body, the size of which can be neglected in the conditions of this task.
Trajectory	A trajectory is a curve that a point describes when moving in space.
Elastic waves	Elastic waves are disturbances propagating in solid, liquid and gaseous media due to the action of elastic forces in them.
Elasticity	Elasticity - the property of bodies to change the shape and size (deformed) under the action of loads and spontaneously restore the original shape and size when external influences cease.
Acceleration	Acceleration - the value characterizing the speed of change of speed.
Oscillation phase	The oscillation phase is an argument of a periodically changing function describing an oscillatory or wave process.
Physiotherapy	Physiotherapy is the use of physical factors for therapeutic purposes.
Physical law	Physical law is a necessary, essential, stable recurring connection between phenomena, processes and states of bodies. The knowledge of physical laws is the main task of physical science.
Physical field	The physical field is a special kind of matter. Physical fields link the constituent parts of a substance into a single system and transfer the action of some particles to others at a finite speed. There are gravitational, electromagnetic and other fields.
Photo effect	Photo effect - a phenomenon associated with the release of electrons in a solid or liquid under the action of electromagnetic radiation. Distinguish between internal, external and valve photo effects.
Electrical Conductivity (Electrical Conductivity)	Electrical conductivity - the ability of a substance to conduct under the action of an unchanging in time electric field an unchanging in time electric current.
Electrical circuit	Electrical circuit - a system of devices that provide the passage of electric current.
Electrical Conductor (Electrical Conductor)	A conductor is a substance with high conductivity. There are conductors of the first kind, in which charge electrons are free electrons (metals) and conductors of the second kind, in which charges are transported by ions (electrolytes)

Electric current	Electric current is an ordered movement of charged particles. The direction of electric current is the direction of ordered motion of positively charged particles.
Electric field	The electric field is a special form of matter, through which the interaction of electrically charged particles.
Electrical resistance	Electrical resistance is the main electrical characteristic of the conductor; the value that characterizes the opposition of an electrical circuit or its portion to an electrical current.
Electrodynamics	Electrodynamics is a field of physics in which the properties and laws of the behavior of an electromagnetic field and the movement of electric charges interacting with each other through this field are studied.
Electrocardiography (ECG)	Electrocardiography is a method of studying the state of the heart by registering the electrical potentials that occur in the heart muscle during its contraction.
Electromagnetic wave	Electromagnetic wave - a wave generated by the oscillation parameter of the electromagnetic field. Depending on the wavelength in vacuum, the radiation
	source and the method of excitation, there are distinguished: low-frequency oscillations, radio waves, infrared radiation, visible radiation, ultraviolet radiation, x-rays, gamma rays.
Electron	An electron is a stable elementary particle, one of the basic structural units of a substance. Electrons consist of the electron shells of atoms of all substances. The movement of electrons determines many electrical phenomena, such as electrical current in metals and vacuum. The electron charge is indivisible and is $-1{,}6021892(46)\times10^{-19}$ C.
Electrostatic field	Electrostatic field - an electric field created by fixed electric charges in the absence of electric currents in them. Characteristics of points of an electrostatic field are tension and potential.
Energy	Energy is a scalar physical quantity that is a single measure of various forms of matter movement and a measure of the transition of matter from one form to another.
Echo (sound)	Echoes are sound waves reflected from an obstacle (buildings, hills, trees) and returned to their source.
Echolocation	Echolocation - the detection and precise determination of the location of the object, its size and speed with the help of a sharply directed beam of ultrasonic waves in water. It is carried out by sonar stations.
Nuclear reactions	Nuclear reactions - transformations of atomic nuclei, caused by their interaction with particles or with each other. Usually, nuclear reactions occur when heavy atomic nuclei are bombarded with lighter nuclei or particles. Nuclear reactions are used to study the structure and properties of atomic nuclei, to obtain nuclear energy and radioactive isotopes.

11. Rating Scale:

BRS points	Traditional points of the Russian Federation	Points ESTC
95-100	5	A
86-94		B
69-85	4	C

61-68	3	D
51-60		E
31-50	2	Fx
0-30		F
51-100	Зачет	Passed

Explanation of ratings:

- A – outstanding answer;
- B – very good answer;
- C – good answer;
- D – quite satisfactory answer;
- E – meets the minimum requirements for a satisfactory answer;
- FX – means that a student can get points only to the minimum satisfactory answer;
- F – unsatisfactory answer (or a repetition of the course in the prescribed manner, or a reason for deduction).

12. Fund of assessment tools for intermediate certification.

12.1. Test Questions for Laboratory Work

Introductory lesson.

Laboratory Work 1.

1. Give the defenition of mathematical pendulum.
2. What are the periodand the frequency of vibrations?
3. What are the displacement and the amplitude of vibrations?
4. Give the definition of harmonic vibrations.
5. Write the equations of harmonic vibrations and draw the graph of these vibrations.
6. What relations connect a period, a frequency and a cyclic frequency?
7. Write the formula of the period of a mathematical pendulum.
8. Are the vibrations of a real pendulum harmonic?
9. Why pendulum being deflected from its equilibrium vibrates?
10. The pendulum's period depends on the bob's mass, does not it?
11. How does the acceleration of gravity change with high over the sea level?

Laboratory Work 2.

1. What is the main difference between the ideal and real liquids?
2. How do the forces of internal friction manifest themselves?
3. What is difference between turbulent and laminar flows?
4. What does the force of internal friction acting on a body moving inside liquid depend on?
5. Put down the Newton's formula for estimating the force of internal friction. Explain, what does the formula describe and what mean all the letter, composing the formula/
6. What does liquid's viscosity depend on?
7. What unit for viscosity you know?
8. Name the force acting on a ball falling nto the liquid.
9. Tell about the character of the ball's motion into the liquid.

10. How does the force of internal friction depend on the speed of the ball's motion?
11. What the main difference between the states of substance from the point of view of molecular physics?
12. Name the main properties of liquids and try to explain them according to molecular physics.
13. Put down the equation of continuity and explain it
14. Put down the Bernoulli equation; explain physical sense of the equation and it is applications in practice.
15. What is the Reighnolts number and what do they use it for?

Laboratory Work 3.

1. Formulate two assumptions under which the gas called perfect. At which conditions real gas can be treated as perfect?
2. Formulate the 1-st law of the thermodinamics.
3. Provide definition of molar specific heat of gas. In the units this physical quantity is measured? Which factor does it depend on?
4. Which of heat capacities, Cv or Cp, is greater? Why?
5. Explain physical sense of the universal gas constant R
6. What is understood as a gas process? In which case it can be plotted on a diagram?
7. Which process is known as an adiabatic one? What happens during adiabatic expansion (compression) of a perfect gas?
8. Provide definition of isochoric, isobaric, and isothermic processes. Write the equations for these processes in the case of a perfect gas.
9. Describe three stages of execution of the laboratory work and explain the gas processes taking place during them.
10. Express the quantity γ via the number of degrees of freedom of gas molecules "i". Explain physical meaning of "i". How much is the value of "i" for air? Why?
11. Can the air be treated as perfect gas in this laboratory work? Prove the answer.

Laboratory Work 4.

1. What do you mean by current intensity? Name it s units.
2. State Ohm's law for the part of the electric circuit.
3. What is meant by *emf*. Call its unit.
4. State Ohm's law for the closed circuit.
5. State and explain Joule's law of the electrical heating. Does Joule's law involve conservation energy?
6. State the principle of potentiometer.
7. Why should an ammeter have low resistance?
8. Why should the resistance of the voltmeter be very high?
9. Why an ammeter is connected in series and a voltmeter in parallel to an electric circuit?
10. Why would happen if we connect an ammeter in parallel and a voltmeter in series in a circuit?
11. State the 1-st Kirchoff's law.
12. When will emf be equal to the potential difference across the terminals of the cell?

Laboratory Work 5.

1. State and explain the Faraday's law of electromagnetic induction.
2. State the Lenz's rule
3. What is self-induction?

4. What is inductive reactance X_L in an a.c circuit? What is the value for d.c?
5. What is capacitive reactance X_C ? What is the value for d.c?
6. What is impedance of an a.c circuit?
7. Distinguish between resistance, reactance, and impedance for an a.c circuit.
8. Discuss the phenomenon of resonance in an L-C-R series a.c circuit.
9. What do you mean by root square (rms) value of a.c. How is it related to the peak value of current?
10. The equation $\varepsilon=\varepsilon_0 \sin\omega t$ represent alternating e.m.f. Explain the equation and draw the graph illustrating the equation.
11. What does an a.c. ammeter measure?
12. Draw time-current graph for d.c and a.c . What are the advantages of a.c over d.c due to which now mostly a.c is used?

Laboratory Work 6.

1. Formulate the laws of reflection and refraction of light.
2. What physical quantities determine the focal length of a lens? Write the formula and explain it.
3. What is an optical power of a lens? What units are used to measure this quantity?
4. Explain the physical sense of the index of refraction of a substance.
5. Put down the formula for converging and diverging lenses.
6. Explain, what is an optical focus of a lens?
7. Construct a ray diagram to show the formation of an image by a converging lens. Consider three different position of an object in reference to the lens.
8. Construct a ray diagram to show the formation of an image by a diverging lens. Consider three different positions of an object in reference to the lens.
9. What is meant by a total reflection? Give the examples of the phenomenon applications in medicine.
10. The real image of a luminous pointer has been formed using a lens. How will the brightness of the image change if we screen half of the lens?

Laboratory Work 7.

1. Explain the phenomenon of an external photoeffect.
2. Formulate the Stoletov's law.
3. Formulate the second and the third laws of photoeffect.
4. Explain the physical meaning of the Einstein's photo-electric equation.
5. How can we find the threshold λ_0 and ν_0 ?
6. Why is saturation current inversely proportional to the square of the distance from a source of light to the photocathode?
7. Describe the work of the experimental installation.
8. Where photoelements are used in practice?
9. Explain the physical meaning of saturation current.
10. Explain the nature of the work of exit of electrons.

Laboratory Work 8.

1. What is the phenomenon of diffraction? Give example of its manifestations in nature.
2. How does the diffraction influence the functioning of such optical instruments as a microscope, photocamera and the like?
3. Formulate the Huigence-Frenel principle and on the basis of it explain the phenomenon of diffraction.

4. Describe the diffractional picture observed from a single slit, a hole, a diffractional grating.
5. How light is produced? What proceeds inside the body when it absorbs or emits light?
6. What is the main condition for obtaining induced radiation?
7. What does the word LASER mean?
8. Name of main peculiarities of laser radiation
9. Laser radiation is polarized due a special device used at the laser's output. Why it is not polarized by nature? Explain the fact.
10. What is X-ray?

Laboratory Work 9.

1. Which method is understood as *electrocardiography* (ECG)? What purposes it is used for in medical practice?
2. Draw the pattern of electric field of the heart using force and equipotential lines. Which charges produce this field? Which simplest system of electric charges can serve as a model of this field?
3. Which physical quantity is called the vector of *dipole moment of the heart* (DMH)? Write the defining formula for DMH vector. Is it constant in modulud? In direction?
4. Which curve is called the vector-cardiogram (VCG)? Draw its typical shape. Which closed loops it consists of? In which way these loops are related to the stages of the circle of heart contraction (CHC)?
5. Which dependence is called the ECG in the 1-st lead? In the II and III leads? In *aVR*, *aVL*, and *aVF* leads? In one of the chest leads?
6. Draw schematically the ECG curve of a healthy man in I-st lead. Which peculiarities of this curve can be marked? Which physical quantities are represented there in horizontal and verical directions? Point out the units of these quantities and approximate order of their values.
7. Draw typical dependence $E_1(t)$ of the projection of DMH vector $\vec{E}$ onto the horizontal direction on time. Does this dependence correspond to the ECG curve in the I lead? Ground the answer. Can one find the direction of DMH vector at some moment of time, using this dependence only?
8. Which physical quantity is measured by the ECG registrator? Draw the functional scheme of the ECG registrator.
9. Which quantity is kown as sensibility of an instrument? Define the sensibility of ECG registrator and call its units and typical values.

Laboratory Work 10.

1. What device is used for X-rays production? Describe (in general terms) the construction of this device.
2. What mechanisms of X-rays production do you know?
3. Describe the process of *decelerated X-ray radiation* production.
4. Describe the process of *characteristic X-ray radiation* production.
5. Explain why decelerated X-ray radiation has a continuous spectrum?
6. Explain why characteristic X-ray radiation has discreet spectrum?
7. How it is possible to change the wavelength of X-rays produced using roentgen tubes?
8. Tell about X-rays applications in medicine.
9. What other applications of X-rays do you know?
10. How to protect people from X-rays effect?

12.2. Approximate questions on the course, submitted to the intermediate certification.

Surface phenomena in fluid
1) The surface energy of the liquid.
2) Additional pressure. Formula Laplace.
3) Wetting. Capillary phenomena.4) Gas embolism.

Fluid viscosity Viscosity test methods
1) Liquid state of matter.
2) Ideal fluid. The continuity equation. Bernoulli's equation.
3) Fluid flow at the site of narrowing of the channel (cholesterol plaques).
4) Fluid flow in the channel with aneurysm.
5) Viscous fluid. Newtonian and non-Newtonian fluids.
6) Newton's formula. Poiseuille formula.
7) Channel hydraulic resistance.
8) Types of fluid flow. Reynolds number.
9) Continuity of blood flow.
10) Methods for determining the viscosity of a liquid (brief overview). 11) Stokes method (derivation of the calculation formula).

Thermodynamics
1) The specific heat of the substance and the molar heat capacity of the gas.
2) The internal energy of an ideal gas. The concept of the number of degrees of freedom.
3) Gas operation in various isoprocesses.
4) The first law of thermodynamics and its appearance for isoprocesses.
5) The Mayer equation.
6) The adiabatic process.

12.3. The list of questions of final certification for the course

Direct and alternating current.
1) Electric current, conditions of occurrence.
2) Current strength. The rate of thermal and directional movement of particles.
3) Resistance - physical meaning and temperature dependence (in metals).
4) EMF. Ohm's law for complete chain.
5) Work and power current.
6) Joule-Lenz law.
7) The phenomenon of electromagnetic induction.
8) Faraday's law and Lenz rule. Self-induction.
9) Generation of alternating current.
10) Active, capacitive and inductive load in the AC circuit.

Electromagnetic radiation of the optical range.
1) The scale of electromagnetic waves and the sources of these waves.
2) Light and its perception by the human eye.
3) Fiber optic fibers and their use in medicine.
4) Interference and diffraction of light.
5) The principle of Huygens-Fresnel.
6) Diffraction of light on the slit. Fresnel zones.
7) The resolution of optical devices.
8) Electron microscope.

9) The laws of reflection and refraction of light. Dispersion.
10) Total internal reflection (phenomenon and application).
11) Lenses. Formula thin lenses.
12) Construction of lenses.
13) Refractive index (absolute and relative). Their physical meaning.
14) Enlightenment of lenses.
15) Microscope (magnification, resolution).
16) Infrared (thermal) radiation and its use in medicine.
17) Luminescence. Fluorescent microscope.
18) Forced radiation. Lasers and their application in medicine.

Optical colorimetry.
1) Absorption of light by matter. Booger's law .
2) Types of optical spectra.
3) Spectral analysis of the substance.

Ionizing radiation.
1) Ultraviolet radiation and its use in medicine.
2) X-ray radiation and its application in medicine.
3) Radioactive radiation and their use in medicine.
4) Radionuclide diagnostic methods in medicine.5) Radiation therapy.
6) Detection and dosimetry of ionizing radiation.

The structure of the atom. Laws of heat radiation
1) The planetary model of the atom and the postulates of Bohr.
2) Heat radiation and its spectrum.
3) Absolutely black body.
4) Kirchhoff law. Law of Wine. The law of Stefan-Boltzmann.
5) Types of radiation spectra.
6) Greenhouse effect.7) Thermal imager.

13. **The list of questions submitted to the test / exam**

The credit is intended for students who have received the letter Fx on the ECTS scale and, thus, have had the opportunity to confirm the level of their knowledge by retake in January / February. The exam is taken orally and implies a satisfactory answer to three of the questions listed below.

The list of questions included in the **test / examination** tickets final certification:

Questions on the course of general physics

1. A pendulum consists of a ball suspended on a weightless string. What are forces that cause it to oscillate? What is the direction of the restoring force? Show the trajectory points at which the restoring force has maximum
2. Two balls of the same size, one aluminium and one lead, are suspended on strings of equal length. The ball is deflected through the same angle and released. Will the period of their oscillations be the same?

3. Simple harmonic motion (S.H. M). Displacement equation of S. H. M Amplitude. Periodic time. Frequency. Phase.
4. What will be change in the period of oscillations of a pendulum if its length is increased four times?
5. Obtain the expression for the acceleration due to gravity in terms of gravitational constant G
6. If the diameter of the earth becomes twice its present value but its mass remains unchanged, then how would be the weight of a object on the surface of the earth effected?
7. Energy transformation in the motion of simple pendulum. Potential energy. Kinetic energy.
8. If a man goes from the surface of the earth to a height equal to the radius of the earth, then what will be his weight relative to that on the earth?
9. Write down and explain the equation of harmonic vibration. Draw the graph of these vibrations.
10. Let bob of the simple pendulum is negatively charged and positively charged metallic plate is placed just below the bob and the pendulum is made to oscillate. What will be the effect on the period of the pendulum?
11. What does liquid's viscosity depend on? Name the force acting on a ball falling into the liquid?
12. Explain with the help of the Bernoulli's equation that for water flowing in a tube of nonuniform cross-section the static pressure in the wider part of the tube is larger than in the narrow part.
13. Velocity of a small metallic ball in viscous fluid becomes constant after some time. Which property of the liquid is responsible for this?
14. Put down the equation of continuity and explain it.
15. Water is flowing in a pipe of non-uniform cross-section, the velocity of water at a point A is four times the velocity at another point B. What will be the diameter of the pipe at the point A as compared to the point B?
16. Why is the pressure of water reduced when it comes to narrow pipe from wide part while flowing?
17. Put down the Bernoulli's equation and explain physical sense of the equation.
18. Prove on the basis of the first law thermodinamics that the change in the internal energy of a system: (I) is equal to the heat given to or taken from the system in isochoric process and (ii) is equal to the work done on the system or by system in adiabatic process.
19. Formulate (by words and mathematically) the 1-st law of thermodinamics.
20. Internal energy of gases. First law of thermodinamics. Isobaric, Isochoric, Isothermal and Adiabatic processes.
21. Which of heat capacities, Cv or Cp, is greater and why?
22. Explain the physical sense of the number of degrees of freedom of gas molecules.
23. Coulomb's law. Electric field. Intensity (or strength) of the electric force.
24. Kirchoff's laws. Joule's law.
25. State Ohm's law for the closed circuit.
26. Why should an ammeter have low resistance?
27. What is difference between the velocity and drift velocity of free electrons?
28. When will “emf” be equal to the potential difference across the terminals of the cell?
29. Can the terminal potential difference of a cell exceed its “emf”?
30. You are given 'n' resistors R. How will you combine them to get (i) maximum, (ii) minimum effective resistance? Find the ratio of the max. to min. resistance.
31. Is the electric current a scalar or a vector? Current density?
32. What are the source of the magnetic field? Which objects does the magnetic field act on?
33. Write the expression for the magnitude of the Lorentz force. Define its direction and general properties.
34. Define physical quantity known as “magnetic flux” and name its unit in SI. Using this quantity, formulate mathematically the Faraday's law of electromagnetic induction.

35. Describe the a.c. circuit containing a current-carrying coil and write down the formula for its effective resistance (impedance).
36. The a.c. circuit contains a capacitor. Give the formula for its impedance.
37. What is the inductive reactance of an a.c circuit? What is its value for d.c?
38. A capacitor C and a resistor R are connected in series in an a.c. circuit. Derive the expression for the impedance Z of the circuit.
39. What are the effective values of current out voltage in an a.c. circuits?
40. Explain the phenomenon of an external photoeffect. How does the emission of photoelectrons depend on the intensity and frequency of the incident light?
41. Write the Einstein's photo-electric equation, giving the meaning of symbols used.
42. Write the laws of photo-electric effect.
43. Are all the photo-electrons emitted with same kinetic energy?
44. What will be the effect on velocity of the emitted photo-electron if the wavelength of incident light is decreased?
45. Explain the meaning of the photo-electric work-function by giving necessary equation.
46. What is ' threshold wavelength' in the photo-electric effect?
47. What is the relation between the work-function and the threshold wavelength of a metal?
48. What is meant by 'threshold frequency' in the photo-electric effect?
49. How do you understand the diffraction of light?
50. Draw a graph to show the relative intensity distribution for a single-slit diffraction pattern.
51. Formulate the Huigence-Frenel principal and on the basis of it explain the phenomenon of diffraction
52. What is the resolution power of an optic microscope? Formulate and explain the Reigleigh criteria for resolution power of optical instrument.
53. What is the smallest object a man can see by naked eye, by an optical microscope? Explain, why it is impossible to see smaller object.
54. Interference of light waves. Constructive and dstructive interference.
55. Coherent sources. Condition for interference in light.
56. Diffraction of light at single-slit. Diffraction grating.
57. If an electron passing through a region is deflected from its path, is it definite indication of the presence of a magnetic field there?
58. An Electron moving with velocity “v” along +X-axis enters a uniform magnetic field “B” directed along +Y-axis. What is the magnitude and direction of the force on the electron?
59. A positive charge is coming directly toward you. What would be the direction of the magnetic field produced due to its motion? If a negative charge be going directly away from you then?
60. What type of the lens is an air bubble inside water?
61. What will be the focal length and power of plane glass plate?
62. Which one of the following is not electromagnetic? Infrared rays, ultraviolet rays, radio waves, sound waves, gamma rays, X-rays.
63. Flash and thunder in the sky are produced simultaneously, but thunder is heard after few seconds and flash is seen, why?
64. Two light-waves of the same intensity are interfering. What will be the intensity of light at a bright fringe compared to the intensity of one of the waves?
65. Which among the X-rays, sound waves and radio-waves can be polarized and why?
66. Do magnetic and electric fields have any effect on X-rays? How is laser radiation different from ordinary light?

14.Methodical instructions for the student.

The student in the course of studying the course should:

- Carefully study the materials characterizing the course and the subject of self-study, which is set out in the educational-methodical complex for the discipline. This will make it possible to clearly imagine both the circle, the topics studied, and the depth of their comprehension.
- Make a selection of literature sufficient to study the proposed topics. In the educational methodical complex presents the main and additional references. They are advisory in nature, this means that there is always literature that may not be included in this list, but is necessary for the development of the topic. It should be borne in mind that we need literature of various kinds.

15. Criteria for assessing student knowledge and competencies

A student cannot be certified if he has not mastered all the topics and sections of the discipline indicated in the summary evaluation table of the discipline "Physics". A section or topic of a discipline is considered mastered if a student has scored more than 50% of the possible number of points in this section (topic). It is also necessary to score more than 50% of the possible number of points for laboratory and test papers. Works do not correspond.

By the decision of the teacher and with the consent of students who have not mastered certain sections (topics) of the discipline, during the academic semester, ongoing monitoring of progress or repeated educational tasks on these topics or sections can be repeated. At the same time, students for this work are credited with the minimum possible positive score.

When a student performs additional learning tasks, or re-passes current monitoring activities, the points received by him are counted in specific topics. In this case, the total amount of points can not exceed the maximum number of points set on these topics.

It is obligatory for students to attend all classes and perform all types of current control activities in a discipline. Late students are not allowed to attend classes. Explanations are not taken into account.

A student is certified only if he scored at least 51 points in a semester. Students who score (31 – 50 points) for a semester must pass the test. A credit can give max 20 points.
Students who have scored less than 31 points for a semester must repeat the course.

The program is compiled in accordance with the requirements of the FSES HE.

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