Federal State Budgetary Educational Institution of Higher Education
"Privolzhsky Research Medical University"
Ministry of Health of the Russian Federation

APPROVED
Vice-Rector for Academic Affairs
_____ E.S. Bogomolova
31 August 2021

WORKING PROGRAM

Name of the academic discipline: **GENERAL AND INORGANIC CHEMISTRY**

Specialty: ***33.05.01 PHARMACY***

Qualification: ***PHARMACIST***

Department: GENERAL CHEMISTRY

Mode of study: **FULL-TIME**

Labor intensity of the academic discipline: (**216 academic hours**)

Nizhny Novgorod
2021

The working program has been developed in accordance with the Federal State Educational Standard for the specialty 33.05.01 PHARMACY approved by Order of the Ministry of Science and Higher Education of the Russian Federation No. 219 dated of March 27, 2018.

Developers of the working program:
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The program was reviewed and approved at the department meeting (protocol No.1, 26.08.2021)

Head of the Department of General Chemistry,
Doctor of Chemistry, Professor Gordetsov A.S. /Gordetsov A.S./

August 26, 2021

AGREED
Deputy Head of EMA ph.d. of biology _____ Lovtsova L.V.

August 26, 2021

1. GOALS AND OBJECTIVES OF MASTERING THE DISCIPLINE

The purpose of mastering the discipline: readiness to use the basic physical, chemical, mathematical and other natural science concepts and methods in solving professional problems; willingness to solve standard tasks of professional activity using information, bibliographic resources, biomedical and pharmaceutical technologies, information and communication technologies and taking into account the basic requirements of information security.

UK-1: The ability to carry out a critical analysis of problem situations based on a systematic approach, to develop an action strategy

GPC-1: the ability to use basic biological, physico-chemical, chemical, mathematical methods for the development, research and examination of medicines, the manufacture of medicines.

The tasks of the discipline are:

- study by students of the properties of inorganic substances;
- acquisition and consolidation of knowledge in the field of synthesis and analysis of organic compounds;
- formation of the ability to use modern methods for establishing the structure of organic compounds;
- acquiring the ability to work in a chemical laboratory using special equipment;
- formation of students' skills in studying scientific chemical literature;
- formation of students' skills for solving problematic and situational problems.

As a result of mastering the discipline, the student must:

Know:

Know - the laws and theory of general and inorganic chemistry, which are the foundation for the development of other natural sciences, special and professional disciplines; modern ideas about the structure of matter, the foundations of the theories of chemical processes, the doctrine of solutions, equilibrium processes in solutions of electrolytes and non-electrolytes, chemistry of elements; the role and significance of the basic concepts, methods and laws of general and inorganic chemistry in pharmacy;

Be able to :

Be able to use the laws and theory of general and inorganic chemistry, which are the foundation for the development of other natural sciences, special and professional disciplines; formation of the ability to use modern theories and concepts of general chemistry to identify fundamental relationships between the position of a chemical element in PS, the structure of its compounds and their physical and chemical properties, biological activity and toxicity; development of all types of nomenclature of inorganic compounds; formation of the ability to calculate

the energy characteristics of chemical processes, determine the direction and depth of their course, methods for calculating chemical equilibria from known initial concentrations and equilibrium constant; the formation of skills in conducting chemical experiments (test-tube reactions, preparation of solutions, determining their density, methods for bringing the mass fraction of a solute to the desired value, using the interpolation method, etc.).

Possess:

1) the skills of safe work in a chemical laboratory, conducting experimental work using chemical glassware and equipment;
2) choose the optimal routes for the synthesis of given organic compounds;
3) skills of independent work with educational, scientific and reference literature;
4) find and use the necessary information to solve synthetic problems.

2. Position of the academic discipline in the structure of the General Educational Program of Higher Education (GEP HE) of the organization

1.1. The discipline General and Inorganic chemistry refers to the core part *(*or *the part formed by the participants of educational relations)* of Block 1 of GEP HE (Academic discipline index). The discipline is studied in I semester.The discipline refers to the educational cycle (section) - the mathematical and natural science cycle of disciplines.

1.2. The basic knowledge necessary for studying the discipline is formed on the basis of general secondary education.

1.3. It is a precursor to the study of disciplines: physical and colloidal chemistry; analytical chemistry; organic chemistry; biological chemistry; toxicological chemistry; pharmaceutical chemistry; biology; pharmacology; pharmacognosy; pharmaceutical technology; general hygiene.

1.4. To study the discipline, knowledge, skills and abilities are required that are formed by previous disciplines: general and inorganic chemistry, physics, computer science, mathematics, physical and colloidal chemistry.

1.5. The study of the discipline is necessary for the knowledge, skills and abilities formed by the subsequent disciplines of the professional cycle: biochemistry, toxicological chemistry and such professional disciplines as biological chemistry, pharmaceutical chemistry, pharmacognosy, toxicological chemistry.

3. RESULTS OF MASTERING THE DISCIPLINE AND INDICATORS OF ACHIEVING COMPETENCES:

The process of studying the discipline is aimed at the formation of the following universal (UC), general professional (GPC):

№ п/п	Competence code	The content of the competence (or its part)	Code and name of the competence acquisition metric			
			know	be able to	possess	Evaluation tools

1.	UC-1	the ability to carry out a critical analysis of problem situations based on a systematic approach, to develop an action strategy	Know the basic biological, physico-chemical, chemical, mathematical methods for the development, research and examination of medicines and medicinal plant materials.	Be able to apply the basic biological, physico-chemical, chemical, mathematical methods for the development, research and examination of medicines and medicinal plant materials.	TOwn the basic biological, physico-chemical, chemical, mathematical methods for the development, research and examination of medicines and medicinal plant materials.	Tests, multiply choice tests, colloquia, credits, exams
2.	GPC-1	the ability to use basic biological, physico-chemical, chemical, mathematical methods for the development, research and examination of medicines, the manufacture of medicines	How to apply the basic methods, methods and means of obtaining storage, processing of scientific and professional information; receive information from various sources, including using modern computer tools, network technologies, databases and knowledge	Work with scientific literature analyze information, conduct searches, turn what is read into tool for solving professional problems Use the rules for constructing chemical formulas, graphs, tables using appropriate computer programs, including for creating computer presentations.	Abili ty and willingness to participate in the formulation of scientific problems and their experimenta l implementat ion Com puter programs for constructing chemical and stereochemi cal formulas of organic compounds and other types of illustrative material.	Tests, multiply choice tests, colloquia, credits, exams

4. Sections of the academic discipline and competencies that are formed when mastering them

№ п/п	Competence code	Section name of the discipline	The content of the section in teaching units
1.	UC-1 GPC-1	Introduction. The structure of matter	Introduction. Safety precautions and rules of work in a chemical laboratory. Nomenclature of inorganic compounds: adapted and non-adapted versions of the IUPAC nomenclature; pharmacopoeial nomenclature of inorganic medicinal substances, international non-proprietary names of medicinal substances of inorganic nature (INN). Fundamentals of quantum mechanics: Planck-Einstein's

			quantum theory of radiation; corpuscular-wave dualism; Louis de Broglie equation; Heisenberg's uncertainty principle. Orbital. Four quantum numbers. Graphic representation of atomic orbitals: electron cloud model, boundary surface, quantum cell. The main regularities of the formation of electron shells of atoms: the principle of least energy, the Pauli prohibition (sublevel, its electronic capacitance; level, electronic capacitance of levels); Hund's rule, an empirical rule for compiling electronic formulas. Periodic law and its modern formulation. Moseley's law. Chadwick's work. Isotopes. The use of "labeled" atoms in medicine. Periodic system (PS) and its variants: short-period and long-period; construction of a short-term version of the PS: period, group, subgroup; 4 families (blocks) of elements. The most important characteristics of atoms, the periodic nature of their change: orbital radius, ionization energy, electron affinity; relative electronegativity, the effects of screening and penetration of electrons to the nucleus, the effect of mutual repulsion of electrons in one layer; secondary and additional periodicity. The main characteristics of a chemical bond are energy, length, valence angle. Essence of Heitler-London's works. The main provisions of the method of valence schemes (VB), two mechanisms for the formation of covalent bonds - exchange and donor-acceptor, electron structural diagrams of molecules, delocalized (multicenter) bond; σ- and π-bond on the example of CO_2 molecule. Hybridization of atomic orbitals Conditions for stable hybridization. Spatial configuration of molecules formed by hybrid and "pure" orbitals. Polarization of a covalent bond. Dipole moment of bond and polar molecule. Properties of compounds with a covalent bond. Ionic bond - the limiting case of a covalent polar bond, its unsaturation, non-directionality. Ionic crystals. Properties of ionic crystals. Disadvantages of the VS method. Method of molecular orbitals. Bonding, loosening and non-bonding σ- and π-molecular orbitals. Intermolecular interaction. Its role in the formation of molecular crystal lattices, in the processes of formation of solutions, electrolytic dissociation. Hydrogen bond. Ion polarization, polarizability and polarizing effect; factors on which they depend: type of electron shell, ionic potential. The definition of the concept is a complex (coordination) compound (CS). The structure of the complex compound: the central atom, ligands, the inner and outer spheres of the CS, the coordination number of the central atom (ion). Types of central atoms according to the structure of electron shells. Types of ligands by donor atom, denticity of ligands, CS nomenclature. Stability of complex compounds; factors on which it depends. Works by Chugaev, Chernyaev. Classification and isomerism of complex compounds. The biological role of complex compounds, metalloenzymes, the chemical basis for the use of complex compounds in pharmacy and medicine. The nature of the chemical bond in complex compounds. Fundamentals of the CS color theory.

2.	UC-1 GPC-1	Fundamentals of the theory of chemical processes	System and environment. System types. System status and status functions. Internal energy of the system. Thermal effects of the reaction. The concept of thermochemistry. Hess's law and consequences from it. The concept of enthalpy. The concept of entropy as a measure of system disorder and its thermodynamic probability. Dependence of the enthalpy and entropy values on the position of the element that forms the chemical compound in PS. Thermodynamic potentials (Gibbs and Helmholtz energies.) Criterion for the spontaneous occurrence of a chemical reaction. Tables of standard changes in thermodynamic quantities. Determination of the direction of the spontaneous occurrence of a chemical reaction. Chemical kinetics. Molecular and formal kinetics, chemical reaction rate. Reactions are simple and complex. The mechanism of chemical reactions. Average and instant reaction speed. Factors affecting the rate of chemical reactions in homogeneous and heterogeneous systems. Dependence of the rate of a simple reaction on concentration. The law of active masses. Reaction order. Reaction rate constant. The dependence of the reaction rate on temperature. Van't Hoff's rule. Arrhenius equation. Activation energy. Dependence of the activation energy on the type of reacting particles. Activation energy of catalytic reactions and the essence of the catalyst. enzymatic catalysis. Reversible and irreversible reactions. state of chemical equilibrium. The difference between the state of chemical equilibrium and the kinetically retarded state of the system. Conditions of chemical equilibrium in homogeneous and heterogeneous systems. Kinetic interpretation of chemical equilibrium. The law of mass action for chemical equilibrium. Concentration equilibrium constant, its physical meaning. Shift in chemical equilibrium. Le Chatelier-Brown principle. Electronic theory of redox reactions (OR) (Pisarzhevsky). OB - properties of elements and their compounds, depending on the position in the PS. Change in the degree of oxidation of atoms of elements in OB reactions. Conjugated oxidizer-reductant pairs. Standard change in the Gibbs energy of OB reactions and standard redox potentials of half-reactions.
3.	UC-1 GPC-1	The doctrine of solutions. equilibrium processes in electrolyte solutions	DISPERSED SYSTEMS. CHARACTERISTICS OF TRUE SOLUTIONS, THEIR ROLE IN PHARMACY AND MEDICINE. CHEMICAL AND PHYSICAL THEORY OF SOLUTIONS. DISSOLUTION PROCESS. CHANGING THE PROPERTIES OF THE SOLUTE AND SOLVENT. SOLVENT PROPERTIES. SOLUBILITY. FACTORS AFFECTING SOLUBILITY. THE PROCESS OF DISSOLUTION, AS A PHYSICAL AND CHEMICAL PROCESS. THERMODYNAMIC ANALYSIS OF THE DISSOLUTION PROCESS. SOLUBILITY OF GASES IN LIQUIDS (HENRY, DALTON, HENRY-DALTON LAWS). DEPENDENCE OF GAS SOLUBILITY ON THE CONCENTRATION OF ELECTROLYTES DISSOLVED IN WATER (SECHENOV'S LAW). COLLIGATIVE PROPERTIES OF SOLUTIONS. OSMOSIS, OSMOTIC PRESSURE. VAN'T HOFF'S LAW. THE ROLE OF OSMOTIC PRESSURE IN BIOLOGY, MEDICINE, PHARMACY. ISOTONIC TO HYPERTONIC SOLUTIONS.

			Basic provisions of the theory of electrolytic dissociation. The processes of ionization and dissociation, the influence of the nature of the solvent and solute on them. Thermodynamic analysis of the dissociation process. The degree of dissociation and its dependence on temperature, ions of the same name, concentration. Strong and weak electrolytes. Ionization (dissociation) constant - Ka, Kb. Dissociation of water molecules. Ionic product of water. Hydrogen index. The concept of indicators. Equilibrium processes in solutions of sparingly soluble electrolytes. Solubility product or solubility constant. Salt hydrolysis. The mechanism of hydrolysis by cation and anion from the standpoint of the polarization interaction of salt ions with water molecules. Thermodynamic analysis of the hydrolysis process. Theories of acids and bases: shortcomings of the Arrhenius theory of acids and bases. Protolytic theory of acids and bases Bronsted - Lowry. Basic definitions. Types of protolytic reactions. Electronic theory of acids and bases. Lewis acids and bases. The concept of hard and soft acids and bases (Pearson's concept). Processes of ionization (dissociation), hydrolysis, neutralization reactions, amphotericity of hydroxides from the point of view of various theories of acids and bases.
4.	UC-1 GPC-1	Chemistry of the elements	Chemistry of elements as a branch of chemistry that studies the properties of elements and their compounds. Classification of elements depending on the structure of valence electron shells (families, blocks). General characteristics (position in the PS, the structure of the electron shells of atoms, possible and manifest oxidation states) of p-elements. Position in PS s-, p-, d-, f-elements. p-Elements III, IV, V, VI (chalcogens), VII (halogens), VIII (noble gases) groups. Changes in the properties of p-elements during the transition from group III to group VIII (radius size, ionization potential, electronegativity, etc., the nature of higher oxides and hydroxides). p-elements of group III. General characteristics. The phenomenon of secondary periodicity in the change of orbital radii and ionization energy, its causes. Electronic scarcity and its influence on the properties of elements and their compounds. Bor. General characteristics (position in the PS, the structure of the electron shells of atoms, possible and manifest oxidation states, being in nature, obtaining, physical properties). Chemical properties. Boranes (boranes). Formation of 3-center communication. Boron hydrochloric acid. Boron oxide, orthoboric acid. Behavior of orthobonic acid in aqueous solutions from the point of view of the electronic theory of acids and bases (Lewis theory). Borates: sodium tetraborate, sodium tetraborate decahydrate (borax), hydrolysis, thermal decomposition of sodium tetraborate; metaborates, "pearls". Esters of boric acid. The reaction of the formation of boron-ethyl ether, the coloring of the flame with volatile boron compounds. The role of boron as a bioelement in the body. The use of boron compounds in medicine, pharmacy. Chemical bases of the toxic action of boron

			compounds. Aluminum. General characteristics. Chemical properties. Aluminum compounds: oxide, hydroxide, preparation, properties, amphotericity from the standpoint of the Arrhenius theory and the protolytic theory of acids and bases. Aluminum salts: alum, their hydrolysis; meta- and ortho-aluminates, complex nature of aluminates in aqueous solutions, complex halides, cryolite. Aluminum hydride, alanates. Chemical basis for the use of aluminum and its compounds in medicine and pharmacy. p-elements of group IV: carbon, silicon, tin, lead. General characteristics. Carbon. Feature of the position of carbon in PS. Carbon as the basis of organic compounds, its biological role. Allotropy; diamond, graphite, carbine, fullerene, graphene. Activated carbon as an adsorbent. Chemical properties of carbon. Carbon monoxide (II) (carbon monoxide). Structure and nature of connections. Redox (RH) properties. Addition reactions. Phosgene. Carbon monoxide (II) as a ligand. metal carbonyls. Chemical basis of carbon monoxide (II) toxicity. Carbon monoxide (IV) (carbon dioxide). The structure of the molecule. Physical and chemical properties. "Dry ice". Liquid CO_2 - as an extractant. CO_2 - extracts, their importance in pharmacy. Carbonic acid. Salts - carbonates, bicarbonates, solubility, hydrolysis, thermal decomposition. Carbamide (urea). Cyanogen. Hydrocyanic (hydrocyanic) acid. Simple and complex cyanides. Chemical bases of toxic action of cyanides. Cyanic and isocyanic acids, their salts. Thiocyanic (thiocyanic) acid and its salts. The use of carbon and its compounds in medicine and pharmacy. The biological role of carbon. Silicon. General characteristics. The main difference from carbon; the absence of □-bonds between silicon atoms in compounds. Silicic acid, fluorosilicates. Oxygen silicon compounds: silicon oxide (IV), silicic acids, silicates (solubility, hydrolysis, qualitative reaction). Isopoly acids and heteropoly acids. silica gel. Zeolites. Glass. Glass leaching. Silicone compounds: silicones, siloxanes. The use of silicon compounds in medicine and pharmacy. Tin, lead. General characteristics. Chemical properties. Compounds Sn (II) and Pb (II): hydroxides, salts, reducing properties of Sn (II) compounds, amphotericity of hydroxides, hydrolysis of salts. Qualitative reactions to Sn (II) and Pb (II) ions. Sn (IV) and Pb (IV) compounds: oxides, hydroxides, salts. Oxidizing properties of lead oxide (IV). The use of lead compounds in medicine. Chemical bases of the toxic action of lead compounds. The use of tin and lead compounds in the analysis of drugs. p-Elements of group V: nitrogen, phosphorus, arsenic, antimony, bismuth. General characteristics of the subgroup. Nitrogen. General characteristics. The structure of the molecule. Chemical properties. Ammonia. Receipt. The structure of the molecule. Physical properties of ammonia.

			Liquid ammonia, hydrogen bonds. Chemical properties: acid-base and redox. Ammonia (amminic CS). Ammonium salts, solubility, thermal stability. Qualitative reactions for ammonia and ammonium ion. Amides: hydrazine, hydroxylamine. Oxygen compounds of nitrogen are oxides. Physical and chemical properties. Nitrous acid and its salts, redox duality. Qualitative reaction to nitrite ion. Nitric acid. Valence diagram of a molecule. Physical and chemical properties. Nitric acid as an oxidizing agent. "Aqua regia". Features of interaction with metals. Nitrates, thermal decomposition, oxidizing properties, qualitative reaction to nitrate ion. Phosphorus. General characteristics. Allotropy. Chemical properties. Compounds of phosphorus with hydrogen (phosphine); with halogens, their hydrolysis. compounds of phosphorus with oxygen. Getting, properties. Phosphorous and phosphorous acids, structural formulas, basicity, reducing properties. Meta-, di- and orthophosphoric acids, their salts Qualitative reactions to ions of phosphorus (V) acids. Dihydrophosphates, hydrophosphates, solubility, hydrolysis. Derivatives of phosphoric acid in living organisms. Isopoly and heteropolyphosphoric acids. biological role. Elements of the arsenic subgroup (arsenic, antimony, bismuth). General characteristics. Hydrogen compounds of arsenic, antimony and bismuth in comparison with ammonia and phosphine. Detection of arsenic by the method of Marsh, Sanger-Black, Gutzeit. Oxygen compounds with oxidation states (III) and (V). Arsenic (III) oxide (arsenic anhydride) arsenic (V) oxide. Acid-base properties of their hydroxides. Salts: arsenites, arsenates, antimonites, antimonates, bismuthates, their redox properties. Qualitative reactions for arsenites, arsenates and bismuth (III) ion. Compounds with halogens, their hydrolysis; sulfides. Arsenic and antimony thiosols. Thioarsenites, thioarsenates and thioantimonites thioantimonates (thiostibites and thiostibates). The concept of the chemical bases of the use in medicine and pharmacy of ammonia, nitric oxide (I) (nitrous oxide), sodium nitrite, oxides and salts of arsenic, antimony and bismuth. Chemical bases of toxic action of nitrates, nitrites of arsenic and antimony. p-Elements of group VI: oxygen, sulfur, selenium, tellurium (chalcogens). General characteristics of the subgroup. Oxygen. General characteristics. Features of the electronic structure of the oxygen molecule. Chemical activity of molecular and atomic oxygen. O2 molecule as a ligand in oxyhemoglobin. Features of the oxide ion, its interaction with water. Ozone. The structure of the molecule. Reaction with iodide solutions. Water. The structure of the molecule. physical properties. water anomalies. Chemical properties. Purified and non-pyrogenic water. Mineral water. The biological role of oxygen and water. Chemical basis for the use of oxygen, ozone and water in medicine and pharmacy. Hydrogen peroxide. The structure of the molecule. Receipt. physical properties. H_2O_2 as an acid. Redox duality of

			hydrogen peroxide, qualitative reaction to the peroxide group. Storage conditions for hydrogen peroxide and its solutions. The use of hydrogen peroxide and peroxide compounds in pharmacy and medicine. Chemical bases of toxicity of endogenous hydrogen peroxide. Sulfur. Selenium. General characteristics. Chemical properties. compounds with hydrogen. Hydrogen sulfide. Preparation, structure of the molecule, physical and chemical properties. Hydrosulfide acid, sulfides, hydrosulfides, solubility, hydrolysis, reducing properties, qualitative reaction. Polysulfides. Sulfur compounds (IV). Oxide, chloride, oxosulfur (IV) chloride. Sulfurous acid and its salts: sulfites, hydrosulfites, their redox duality, qualitative reaction. Disulfurous and sulphurous acids and their salts. Sulfur (VI) compounds: oxide, dioxosulfur chloride (sulphuryl chloride). Sulfuric acid, oleum, disulfuric acid. Sulphates, their solubility in water, thermal stability, qualitative reaction. Thiosulfuric acid, thiosulfates, preparation, reactions with acids, oxidizing agents: chlorine water, iodine, iron (III) chloride. Peroxomono- and peroxodisulfuric acids, peroxosulfates, their oxidizing properties, polythiosulfuric acid, polythionates, features of their structure, reducing properties. The use of sulfur and its compounds in medicine and pharmacy. The biological role of sulfur and selenium. p-Elements of group VII: fluorine, chlorine, bromine, iodine, astatine (halogens). General characteristics. Special properties of fluorine as the most electronegative element. Simple substances, their chemical activity. Compounds of halogens with hydrogen. Receipt. Solubility in water, polarizability, dissociation. Acid and reducing properties. Salts of hydrohalic acids. The ability of a fluoride ion as a rigid base (ligand) to replace oxygen (for example, in silicon compounds). Halide ions as ligands in CC. Qualitative reactions to halogenide ions. Polyiodides. Compounds of halogens in positive oxidation states: compounds with oxygen and with each other. Interaction of halogens with water, aqueous solutions of alkalis. Chlorine oxoacids, structure; dependence of the strength of acids, their oxidizing properties and stability on the oxidation state of chlorine (ionic potential value) active chlorine preparations: bleach, chlorine water, chlorates, bromates and iodates and their properties. The biological role of halogens. Chemical bases of the bactericidal action of chlorine and iodine. Application in medicine, sanitation and pharmacy of halogen preparations. d-elements. General characteristics. position in PS. Characteristic features: variable oxidation states, the formation of complex compounds, the color of compounds and the reasons for its occurrence. Secondary periodicity in subgroups of d-elements. Crystal structure of metals. Metal connection. d-Elements of group III - scandium, IV - titanium, zirconium, V - vanadium, niobium and tantalum.

			d-Elements of group VI: chromium, molybdenum, tungsten. General characteristics. Similarities and differences from group VI p-elements. Compounds of chromium (II) and (III): oxides and hydroxides of chromium. Amphotericity of chromium (III) hydroxide from the standpoint of the theory of acids and bases of Arrhenius and protolytic. Salts of chromium (III), solubility, hydrolysis. Alum. complex compounds. Reducing properties of chromium(III) compounds. Chromium(VI) compounds. Oxide. Chromic and dichromic acids. Salts, chromates and dichromates. Equilibrium in solution between chromate and dichromate ions. their oxidizing properties. Chrome mix. Peroxide compounds of chromium (VI). Compounds of molybdenum, tungsten: isopoly and heteropoly acids. The biological role of chromium and molybdenum. The use of chromium and molybdenum compounds in pharmacy. d - Group VII elements: manganese. Subgroup of manganese (manganese, technetium, rhenium). General characteristics. Similarities and differences from p-elements of group VII. Manganese. Properties of oxides and hydroxides of manganese (II) and (III). Salts, solubility, hydrolysis, qualitative reaction to manganese (II) ion. Manganese(IV) oxide. redox properties. Salts of manganese (VI) - manganates. Manganese(VII) oxide. manganese acid. Salts of manganese (VII) - permanganates: thermal decomposition, oxidizing properties, their dependence on the pH of the medium. Chemical basis for the use of potassium permanganate in medicine. General patterns of changes in the acid-base and redox properties of d-element compounds during the transition from lower to higher oxidation states (on the example of manganese compounds). The biological role of manganese. d-Elements of group VIII: iron, cobalt, nickel. General characteristics, design features of group VIII of the periodic system of elements. Triads. The iron family (iron, cobalt, nickel). Ferromagnetism. Iron. General characteristics. Chemical properties. Compounds of iron (II) and iron (III): oxides and hydroxides, salts (solubility, hydrolysis, redox properties). Complex compounds of iron with cyanide-, thiocyanate (thiocyanate) - ions. Ferrates. Receipt. oxidative properties. Qualitative reactions to iron(II) and (III) ions. The biological role of iron. Chemical basis for the use of iron and iron-containing preparations in medicine and pharmacy. The most important compounds of cobalt (II) and cobalt (III), nickel (II). Formation of complex compounds. The biological role of cobalt and nickel. platinum metals. General characteristics. The use of platinum metals as catalysts. Complex compounds of platinum. Application in medicine. d-Elements of group I: copper, silver, gold. General characteristics. Comparison with s-elements I group. Finding in nature, obtaining, applying. Copper (I) and (II) compounds, acid-base and redox characteristics. Complex

			compounds of copper (II) with ammonia (ammonia), hydroxide ions, amino acids and polyhydric alcohols (chelates). The nature of the color of copper compounds. Qualitative reaction to the copper (II) ion. Copper-containing enzymes, chemical bases of their action. The biological role of copper. Silver (I) compounds: oxide, preparation, solubility in water. Salts: nitrate, halogenides. Oxidizing properties of silver (I). Complex compounds with ammonia, halide and thiosulfate ions. Qualitative reaction to the silver ion (I). Chemical basis for the use of copper and silver compounds in medicine and pharmacy. Gold. Compounds of gold (I) and gold (III), redox properties. The ability of gold (I) and gold (III) to complex formation. Chemical bases, application of gold compounds in medicine and pharmacy. d-Elements of group II: zinc, cadmium, mercury. General characteristics of d-elements of group II. Zinc and its compounds: oxide, hydroxide, amphotericity from the standpoint of the theory of acids and bases of Arrhenius and protolytic; salts, solubility and hydrolysis; complex compounds, metalloenzymes. qualitative reaction to zinc ions. The biological role of zinc. Mercury, features of the chemical properties of mercury; mercury (II) compounds: oxide, chloride, mercury nitrate; amide chloride. Qualitative reactions to cadmium and mercury (II) ions. Mercury (I) compounds. Toxicity of cadmium and mercury compounds, its chemical bases. s-elements. Hydrogen. Hydrogen. General characteristics. Features of the position in the PS. Reactions with oxygen, halogens, metals, oxides. Characterization of the bond of hydrogen with oxygen, sulfur, carbon. Features of the behavior of hydrogen in compounds with strong and weakly polar bonds. Hydrogen ion, oxonium ion, ammonium ion, electronic structure, characteristic. s-Elements of groups I and II: general characteristics (type of electron shells of ions, polarizing effect, hydration energy, color in aqueous solutions). Compounds with oxygen: oxides, peroxides, superoxides, ozonides. Hydrides, their reducing ability. Hydroxides, amphoteric beryllium hydroxide. Salts: sulfates, halides, carbonates, phosphates. Flame coloring with volatile salts of alkali and alkaline earth metals. Ions of s-metals as complexing agents. Ionophores and their role in the membrane transport of potassium and sodium ions. The role of s-metals in the mineral balance of the body. Micro and macro s-elements. Entry into the body with water; hardness of water, units of its measurement; influence on living organisms and the course of reactions in aqueous solutions. Methods for eliminating stiffness. Calcium compounds in bone tissue, similarity of calcium and strontium ions, isomorphic substitution. beryllium toxicity. Chemical bases for the use of lithium, sodium, potassium, magnesium, calcium, barium compounds in medicine and pharmacy.

5. Volume of the academic discipline and types of academic work

Type of educational work	Labor intensity		Labor intensity (AH) in semesters	
	volume in credit units (CU)	volume in academic hours (AH)	3	4
Classroom work, including	**5,6**	**202**	**108**	
Lectures (L)	0,67	24	24	
Laboratory practicum (LP)*	2,33	84	84	
Practicals (P)	-	-	-	
Seminars (S)	-	-	-	
Student's individual work (SIW)	2	72	72	
exam	1	36	36	
TOTAL LABOR INTENSITY	6	216	216	

6. Content of the academic discipline

6.1. Sections of the discipline and types of academic work:

№	№ semester	Name of the section of the academic discipline	Types of academic work* (in AH)					Evaluation tools
			L	LP	P	S	SIW	
1	3	Introduction. The structure of matter.	4	14		-	18	Multiply choice tests, tests or colloquia, survey, exam
2	3, 4	Fundamentals of the theory of chemical processes.	4	14	-	-	18	Multiply choice tests, tests or colloquia, laboratory works, survey, exam
3	4	The doctrine of solutions. equilibrium processes in electrolyte solutions	4	14	-	-	18	Multiply choice tests, tests or colloquia, laboratory works, survey, exam

4	4	Chemistry of the elements	12	42	-	-	18	Multiply choice tests, tests or colloquia, laboratory works, survey, exam
5	4	Экзамен					**36**	
		TOTAL **216 AH**	**24**	**84**			**72+36**	

* - L – lectures; LP – laboratory practicum; P – practicals; S – seminars; SIW – student's individual work.

6.2. Thematic schedule of educational work types:

6.2.1 Thematic schedule of lectures

№	Name of lecture topics	Volume in AH	
		semester 1	semester 2
1.	Introduction. Basic concepts of chemical thermodynamics. Energy of chemical reactions.	4	
2.	The doctrine of solutions. Equilibrium processes in electrolyte solutions.	4	
3.	The structure of the atom and the periodic law. Chemical bond. The structure of chemical compounds.	4	
4.	Chemistry of elements.	2	
5.	S-elements.	2	
6.	P-elements.	4	
7.	D-elements.	4	
	TOTAL (24AH)	24	

6.2.2. The thematic plan of laboratory practicums

№	Name of laboratory practicums	Volume in AH	
		Semester 1	Semester 2
1.	Subject and tasks of general and inorganic chemistry. Solutions. Methods for expressing the concentration of solutions. Familiarization with the rules of work and safety in the chemical laboratory. Introduction to chemicals. Determination of the initial level of knowledge of students. Nomenclature of inorganic substances. Methods for expressing the concentration of solutions.	4.2	
2.	Preparation of solutions of a given concentration. Preparation of a solution of a given concentration from a sample, fixanal.	4.2	

	Preparation of a 0.1 N solution of mineral acids from concentrated solutions.		
3.	Elements of chemical thermodynamics. Laboratory work Determination of the enthalpy of reaction. Registration of the protocol of laboratory work.	4.2	
4.	Elements of chemical kinetics. chemical balance. The dependence of the reaction rate on temperature, concentration. Influence of various factors on the shift of chemical equilibrium.	4.2	
5.	Final lesson on the topics: concentration of solutions, energetics of chemical reactions, chemical equilibrium. Colloquium.	4.2	
6.	Properties of solutions of non-electrolytes and electrolytes. Purification of compounds by recrystallization. Melting point determination.	4.2	
7.	Ionic equilibrium in solutions of strong and weak electrolytes. Determination of the pH of solutions using an indicator. Influence of the ion of the same name on the degree of dissociation of weak electrolytes. Salt hydrolysis. Conditions for the precipitation and dissolution of precipitates of sparingly soluble compounds. Obtaining and studying the properties of amphoteric electrolytes.	4.2	
8.	Redox reactions. Redox properties of simple substances, the most important oxidizing agents ($KMnO_4$, $K_2Cr_2O_7$). Properties of substances with dual redox ability. Laboratory work.	4.2	
9.	Final lesson on the topics: properties of solutions of electrolytes and non-electrolytes. Redox reactions. Test.	4.2	
10.	The structure of the electron shells of atoms. Periodic law and periodic system of elements D.I. Mendeleev. Chemical bond. The structure of molecules.	4.2	
11.	Complex compounds. Obtaining and studying the properties of complex compounds of copper, nickel, silver, iron. Test control: atomic structure, chemical bond.	4.2	
12.	Introduction to the chemistry of elements. S - elements of I and II groups. Properties of simple substances. Chemical properties of hydrogen peroxide. Properties of magnesium and its compounds. Obtaining and studying the properties of hydroxides and sulfates of alkaline earth metals.	4.2	
13.	d- elements. Elements of VI and VII groups. Study of acid-base and redox properties of chromium (III), (VI) compounds. Redox properties of manganese (II), (IV), (VI), (VII) compounds.	4.2	
14.	d - elements of I, II, VIII groups. Solution of typical and system tasks. Communications on the themes of abstracts.	4.2	
15.	Final lesson on topics:	4.2	

	complex compounds. S-, d-elements. Test.		
16.	p - elements. Elements III, IV, V groups. Solution of typical and system tasks.	4.2	
17.	p - elements of VI and VII groups. Solution of typical and system tasks. Communications on the themes of abstracts.	4.2	
18.	Final lesson on p-elements. Colloquium.	4.2	
19.	Final test control.	4.2	
	TOTAL (total 84 AH)	80	62

6.2.3. Thematic plan of practicals: not provided for.

6.2.4. Thematic plan of seminars: not provided for.

6.2.5. Types and topics of student's individual work (SIW)

№	Types and topics of SIW	Volume in AH	
		Semester 1	Semester 2
1.	work with lecture material, providing for the development of lecture notes and educational literature, work with electronic literature;	20	
2.	doing homework for class;	15	
3.	preparation for control work;	15	
4.	preparation for testing online;preparation for testing online;	22	
	TOTAL (total 72AH)	72	

6.2.6. Student's research work:

№	Student's research work:	Semester
1.	Group VI p-elements - sulfur and selenium, their role in biology, medicine and pharmacy.	1
2.	Medicines based on selenium and sulfur.	
3.	Sulfur and its compounds in biology, medicine, pharmacy.	
4.	Chemical basis for the use of oxygen and ozone, as well as oxygen compounds in medicine and pharmacy.	
5.	Application of hydrogen peroxide and peroxide compounds in pharmacy and medicine.	
6.	Chemical bases of endogenous hydrogen peroxide toxicity.	
7.	Acid rains and their impact on the environment and human health.	
8.	Group VII p-elements, their role in biological systems, medicine and pharmacy.	
9.	Iodine and human health.	
10.	Chemical bases of the bactericidal action of chlorine and iodine.	
11.	Biogenic role of macronutrients.	
12.	p-Elements of group V in biology, medicine and pharmacy.	
13.	"Royal vodka". Features of interaction with metals. Derivatives of	
14.	phosphorus (V) in living organisms.	
15.	Isopoly- and heteropolyphosphoric acids. Biological role.	
16.	Chemical bases of the toxic action of nitrates, nitrites, arsenic and antimony compounds.	
17.	Group III p-elements in biology, medicine and pharmacy.	
18.	The role of boron as a bioelement in the body.	

19.	Chemical basis for the use of aluminum and its compounds in medicine and pharmacy.	
20.	Group IV p-elements in biology, medicine and pharmacy.	
21.	Liquid CO_2 - as an extractant. CO_2 - extracts, their importance in pharmacy.	
22.	Thallium as a metal is a toxicant.	
23.	Use of tin and lead compounds in drug analysis.	
24.	Chemistry of obtaining window glass ($Na_2O·CaO·6SiO_2$) and crystal.	
25.	Modern theories of chemical bonding in complex compounds.	
26.	Macrocyclic ligands and nanotechnologies. Their complexes and application in medicine.	
27.	Toxic effect of heavy metals and occupational poisoning.	
28.	Metals - toxicants and environmental pollution.	
29.	Toxic metals (cadmium, mercury, lead).	
30.	Salts of heavy metals - antiseptics.	

7. Types of assessment formats for ongoing monitoring and mid-term assessment

№	Semester No.	Types of control	Name of section of academic discipline	Competence codes		
					types	number of test questions
1.	3	Current monitoring	Fundamentals of the structure and general laws of the reactivity of organic compounds.	1, 2, 3- Current testing. Testing practical skills. test or colloquium	4	15
2.	3	Current monitoring	Reactivity of hydrocarbons.	1 - Current testing. Oral individual survey. 2 - Current testing. Test work or colloquium. 3 - Current testing. Oral individual survey.	5	15
3.	3	Current monitoring	Alcohols, phenols, ethers and their thioanalogues.	1 - Current testing. Oral individual survey. 2 - Current testing. Test work or colloquium. 3 - Current testing. Oral individual survey.	5	13
4.	3	Current monitoring	carbonyl compounds. Carboxylic acids and their derivatives.	1 - Current testing. Oral individual survey. 2 - Current testing. Test work or colloquium. 3 - Current testing. Oral individual survey.	5	15

5.	4	Current monitoring	Carboxylic (mono-, di- and heterofunctional) acids.	1 - Current testing. Oral individual survey. 2 - Current testing. Test work or colloquium. 3 - Current testing. Oral individual survey.	4	15
6.	4	Current monitoring	Carbohydrates: mono-, di- and polysaccharides.	1 - Current testing. Oral individual survey. 2 - Current testing. Test work or colloquium. 3 - Current testing. Oral individual survey.	4	15
7.	4	Current monitoring	heterocyclic compounds. Nucleosides, nucleotides, nucleic acids.	1 - Current testing. Oral individual survey. 2 - Current testing. Test work or colloquium. 3 - Current testing. Oral individual survey.	4	15
8.	4	Exam	All topics	Computer testing	12	60 (option is formed by random sampling)
				Exam cards	3	30

8. Educational, methodological and informational support for mastering the academic discipline (printed, electronic publications, the Internet and other network resources)

8.1. Key literature references

№	Наименование согласно библиографическим требованиям	Количество экземпляров	
		на кафедре	в библиотеке
1.	Ebbing, D. D. General Chemistry / D. D. Ebbing, S. D. Gammon. – 11th ed. – Australia : Cengage Learning, 2019. – 864 p. : il. – ISBN 978-1-3055-8034-3.	-	50

8.2. Further reading:

8.3. Electronic educational resources for teaching academic subjects

8.3.1. Internal Electronic Library System of the University (IELSU)

№	*Name of the electronic resource*	*Brief description (content)*	*Access conditions*	*Number of users*

8.3.2. Electronic educational resources acquired by the University

№	*Name of the electronic resource*	*Brief description (content)*	*Access conditions*	*Number of users*
1.	International scientometric database "Web of Science	Web of Science covers materials on natural,	Free access from PIMU computers	Free access from PIMU computers

	Core Collection"	technical, social, humanities; takes into account the mutual citation of publications developed and provided by Thomson Reuters; has built-in search, analysis and management of bibliographic information.	[Electronic resource] - Access to the resource at: http://apps.webofknowledge.com	

8.3.3 Open access resources

№	*Name of the electronic resource*	*Brief description (content)*	*Access conditions*
1.	Federal Electronic Medical Library (FEMB)	Includes electronic analogues of printed publications and original electronic publications that have no analogues recorded on other media (dissertations, abstracts, books, magazines, etc.). [Electronic resource] – Access mode: http://нэб.рф/	from any computer on the Internet
2.	Scientific electronic library eLIBRARY.RU	The largest Russian information portal in the field of science, technology, medicine and education, containing abstracts and full texts of scientific articles and publications. [Electronic resource] - Access mode: https://elibrary.ru/	from any computer on the Internet
3.	Scientific electronic library of open access CyberLeninka	Full texts of scientific articles with annotations published in scientific journals in Russia and neighboring countries. [Electronic resource] - Access mode: https://cyberleninka.ru/	from any computer on the Internet

9. Material and technical support for mastering an academic discipline

9.1. List of premises for classroom activities for the discipline

1. Lecture hall equipped with multimedia equipment and a microphone.
2. Rooms for laboratory workshops.

9.2. List of equipment for classroom activities for the discipline

1. Multimedia complex (computer and projection equipment)
2. Information stands.
3. Tables and directories.
4. Slides and multimedia presentations of lectures.
5. Chemical glassware (burettes, pipettes, flasks, glasses, refrigerators, chemical reagents).
6. Chemical reagents.
7. Hood.
8. Spirit lamps.
9. Electric stoves.
10. Analytical balance.
11. Water bath.
12. Test tube racks.
13. Reagent racks.
14. Magnetic stirrers..

9.3. A set of licensed and freely distributed software, including domestic production

Item no.	Software	number of licenses	Type of software	Manufacturer	Number in the unified register of Russian software	Contract No. and date
1	Wtware	100	Thin Client Operating System	Kovalev Andrey Alexandrovich	1960	2471/05-18 from 28.05.2018
2	MyOffice is Standard. A corporate user license for educational organizations, with no expiration date, with the right to receive updates for 1 year.	220	Office Application	LLC "NEW CLOUD TECHNOLOGIES"	283	without limitation, with the right to receive updates for 1 year.
3	LibreOffice		Office Application	The Document Foundation	Freely distributed software	
4	Windows 10 Education	700	Operating systems	Microsoft	Azure Dev Tools for Teaching Subscription	
5	Yandex. Browser		Browser	«Yandex»	3722	
6	Subscription to MS Office Pro for 170 PCs for FGBOU VO "PIMU" of the Ministry of Health of Russia	170	Office Application	Microsoft		23618/HN10030 LLC "Softline Trade" from 04.12.2020

10. List of changes to the working program (to be filled out by the template)

Position	Number and name of the program section	Contents of the changes made	Effective date of the changes	Contributor's signature
1				

Federal State Budgetary Educational Institution of Higher Education
"Privolzhsky Research Medical University"
Ministry of Health of the Russian Federation
(FSBEI HE "PRMU" of the Ministry of Health of Russia)

Department of
General Chemistry

CHANGE REGISTRATION SHEET

working program for the academic discipline
General and Inorganic Chemistry

Field of study / specialty / scientific specialty: 33.05.01 "PHARMACY"

Training profile: PHARMACIST

Mode of study: Full-time

Approved at the department meeting
Protocol No. 1, of August 26, 2020

Head of the Department
of General Chemistry,
Doctor of Chemistry, Professor Gordetsov A.S /Gordetsov A.S./