**Додаток 2**
*До Процедури розробки та періодичного перегляду освітніх програм*

## SYLLABUS OF THE ACADEMIC DISCIPLINE "GENERAL AND INORGANIC CHEMISTRY"

| 1. General information | |
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| **Faculty** | Pharmacy |
| **Programme** | 22 Health care, 226 Pharmacy, industrial pharmacy, 2nd Master's degree of Higher education, full-time |
| Academic year | 2023-2024 |
| Subject | General and Inorganic chemistry, OK 10<br>https://new.meduniv.lviv.ua/osvitni-programy/ |
| Department | Department of General, Bioinorganic, Physical and Colloidal Chemistry, 52 Pekarska str., Lviv, 79010<br>Telephone: +38 (032) 2754987,<br>Shymzeriv str. 1a, Lviv,79010<br>Telephone: +38 (032) 2786431,<br>e-mail: kaf_genchemistry@meduniv.lviv.ua |
| Head of the Department | Iryna V. Drapak, DSc, PhD in Pharmacy, Professor,<br>e-mail: drapak_iryna@meduniv.lviv.ua |
| Year | 1st year |
| Semester | I, II semesters |
| Type of the Subject | obligatory |
| Professors | Oleksandra Roman, PhD in Pharmacy, Assoc. Professor, e-mail: lesia_roman@ukr.net<br>Olena Klenina, PhD in Pharmacy, Assoc. Professor,e-mail: olena_klenina@yahoo.com<br>Marta Sulyma, PhD in Pharmacy, Assist. Professor,e-mail: sumarta145@gmail.com<br>Iryna Myrko, Assist. Professor, e-mail: irynaoliinyk@gmail.com |
| Erasmus | Yes |
| Responsible for Syllabus | Oleksandra Roman, Assoc. Professor, e-mail: lesia_roman@ukr.net |
| Credits ECTS | 9 |
| Hours | Lectures – 30 h; Practical classes – 105 h; Individual work – 135 h |
| Language of instruction | English |
| Consultations | Consultations take place according to the approved schedule, both offline (face-to-face) and online, using ICT available to students |

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| | and teachers |
| Address, telephone and regulations of the clinical base, office | – |

**2. Course overviev**

The main objective of the General and Inorganic Chemistry Course is to introduce the basic principles and methodologies of Chemistry to create a sound starting point for the study and comprehension of the correlation between structure and the properties of materials which students will have to study in more detail in the following years. In particular, by means of simple teaching laboratory experiences carried out alongside the theoretical lessons, students should develop the ability to apply critical reasoning, in particular regarding the ability to apply the concepts of basic Chemistry to simple practical problems or simple phenomena.
Knowledge of inorganic chemistry will enable the future specialist to master the most essential skills of qualitative and quantitative prediction of the probability of the course of chemical reactions and the establishment of mechanisms for the interaction of inorganic substances used in medical and pharmaceutical practice, as well as their biotransformation in the human body.

**3. The goal and tasks of the discipline**

1. The goal of the academic discipline “General and Inorganic Chemistry” studying is the scientific outlook of students formation, the contemporary forms of their theoretical thinking development and the ability to analyze phenomena, the skills and abilities formation for the chemical and physico-chemical laws and processes application during the other disciplines studying and in future practical activities.
2. The main tasks of studying the discipline "General and Inorganic Chemistry" is to teach students to use the basic concepts of chemistry, the basic laws of chemistry, the theory of atomic structure, and chemical bonds, the theory of solutions, general information about chemical elements and their compounds in solving specific problems in the field of pharmacy in accordance with current needs.
3. The course provides the students’ competences according to the requirements of the High education standard:

– *general**:***
  – the ability to act socially responsibly and civically consciously
  – the ability to apply knowledge in practical situations;
  – the desire to preserve the environment;
  – the ability to abstract thinking, analysis and synthesis; ability to learn and be modernly trained;
  – knowledge and understanding of the subject and profession;
  – the ability to assess and ensure the quality of work;
  – the ability to conduct research at the appropriate level.

– *special (professional, substantive):*
  – the ability to organize the activities of pharmacies for the preparation of medicinal products in various forms on the basis of doctor’s prescriptions of and orders of medical institutions, including the substantiation of technology and selection of auxiliary materials in accordance with the rules of GPP.
  – the ability to organize and participate in the production of medicines in terms of pharmaceutical companies, including the selection of the process of substantiation process and the choice of equipment according to the requirements of good manufacturing practice GMP.
  – the ability to develop methods for quality control of medicinal products, pharmaceutical substances, medicinal plant materials and excipients using physical, chemical and physico-chemical methods of control.
  – the ability to determine drugs and their metabolites in biological fluids and tissues of the body, conduct chemical and toxicological studies to diagnose acute poisoning, narcotic and alcoholic intoxication.

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| – the ability to ensure proper storage of medicines and medical devices according to their physical and chemical properties in health care. | | |
| **4. Prerequisites of the Course** | | |
| General and Inorganic chemistry as an academic discipline:<br>1. Based on previously studied by students subjects in secondary school such as Chemistry, Elementary Mathematics and Physics. | | |
| **5. Results of the Course** | | |
| **Results** | | |
| **Code of the learning outcomes** | **The content of the learning outcomes** | **Matrix of competencies** |
| Зн – knowledges<br>Ум – skills<br>АВ – independence and responsibility<br>К – competence | | |
| *Зн-1* | to know the safety rules in the chemical laboratory | *ПР3* |
| *Зн-2* | to know basic concepts and laws of chemistry | *ПР2, ПР26, ПР27* |
| *Зн-3* | to know the classification of inorganic compounds, methods of obtaining and chemical properties | *ПР2, ПР26, ПР27* |
| *Зн-4* | to know the essence of the periodic law and the structure of the periodic table;d their relationship with the structure of the atom | *ПР2, ПР26, ПР27* |
| *Зн-5* | to know modern theories of the structure of atoms | *ПР2, ПР26, ПР27* |
| *Зн-6* | to know the concept of quantum numbers and their physical meaning | *ПР2, ПР26, ПР27* |
| *Зн-7* | to know the types of chemical bonds, valence capabilities of elements and the dependence between chemical bonds and molecule geometry | *ПР2, ПР26, ПР27* |
| *Зн-8* | To know the concept of "solvent", "solute", "solution concentration" | *ПР2, ПР26, ПР27* |
| *Зн-9* | toknow the concept of colligative properties of solutions | *ПР2, ПР26, ПР27* |
| *Зн-10* | to know and understand the basic thermodynamic state functions and their use in chemistry | *ПР2, ПР26, ПР27* |
| *Зн-11* | to know the features of reversible chemical reactions | *ПР2, ПР26, ПР27* |
| *Зн-12* | to know the dependence of the rate of chemical reactions on various factors | *ПР2, ПР26, ПР27* |
| *Зн-13* | to know the causes and patterns of electrolytic dissociation of acids, bases and salts | *ПР2, ПР26, ПР27* |
| *Зн-14* | to know the concepts of "degree of electrolytic dissociation", "dissociation constant", "pH", "$K_{sp}$" | *ПР2, ПР26, ПР27* |
| *Зн-15* | to know and classify protolytic processes | *ПР2, ПР26, ПР27* |
| *Зн-16* | to know the phenomenon of redox processes | *ПР2, ПР26, ПР27* |
| *Зн-17* | to know the concepts of "oxidation agent", "reducing agent", oxidation and reduction processes, "oxidation state" | *ПР2, ПР26, ПР27* |

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| *Зн-18* | to know the basic principles of coordination theory | *ПР2, ПР26, ПР27* |
| *Зн-19* | to know the nature of the interaction between atoms and methods of molecule formation | *ПР2, ПР26, ПР27* |
| *Зн-20* | to know the classification of complex compounds | *ПР2, ПР26, ПР27* |
| *Зн-21* | to know the concept of "chemical element", "biosphere", "noosphere" | *ПР2, ПР26, ПР27* |
| *Зн-22* | to know the classification of chemical elements | *ПР2, ПР26, ПР27* |
| *Зн-23* | to know the properties of hydrogen and its compounds | *ПР2, ПР26, ПР27* |
| *Зн-24* | to know the physical and chemical properties of water | *ПР2, ПР26, ПР27* |
| *Зн-25* | to know the properties of alkali metals | *ПР2, ПР26, ПР27* |
| *Зн-26* | to know the properties of alkaline earth metals | *ПР2, ПР26, ПР27* |
| *Зн-27* | to know the identification reactions of $Ca^{2+}$, $Mg^{2+}$, $Sr^{2+}$, $Ba^{2+}$ cations | *ПР2, ПР26, ПР27* |
| *Зн-28* | to know the properties of Boron and its compounds | *ПР2, ПР26, ПР27* |
| *Зн-29* | to know the properties of aluminum and its compounds | *ПР2, ПР26, ПР27* |
| *Зн-30* | to know the chemical properties of elements of IVA group and their compounds | *ПР2, ПР26, ПР27* |
| *Зн-31* | to know the chemical properties of elements of VA group and their compounds | *ПР2, ПР26, ПР27* |
| *Зн-32* | to know the properties of simple substances and compounds of the VIA subgroup elements | *ПР2, ПР26, ПР27* |
| *Зн-33* | to know the properties of oxygen as a simple substance, allotropic modifications of Oxygen | *ПР2, ПР26, ПР27* |
| *Зн-34* | to know the chemical properties of elements of VIIA group and their compounds | *ПР2, ПР26, ПР27* |
| *Зн-35* | to know the identification reactions of halogens ions | *ПР2, ПР26, ПР27* |
| *Зн-36* | to know the general characteristics of the p-elements VIIIA group | *ПР2, ПР26, ПР27* |
| *Зн-37* | to know the chemical properties of metals - the reactions with water, acids, alkalis, salts | *ПР2, ПР26, ПР27* |
| *Зн-38* | to know the properties of the elements of the IB group and their compounds | *ПР2, ПР26, ПР27* |
| *Зн-39* | to know the properties of the elements of group IIB and their compounds | *ПР2, ПР26, ПР27* |
| *Зн-40* | to know the general characteristics of the elements of IIIB - VB groups and their compounds | *ПР2, ПР26, ПР27* |
| *Зн-41* | to know the chemical properties of the VIB group and their compounds | *ПР2, ПР26, ПР27* |
| *Зн-42* | to know the chemical properties of group VIIB and their compounds | *ПР2, ПР26, ПР27* |
| *Зн-43* | to know the properties of simple substances and compounds of the iron family elements, identification reactions of $Fe^{2+}$ and $Fe^{3+}$ ions | *ПР2, ПР26, ПР27* |
| *Зн-44* | to know the properties of platinum metals and their applications | *ПР2, ПР26, ПР27* |
| *Ум-1* | be able to experimentally obtain some inorganic compounds and check their properties | *ПР2, ПР26, ПР27* |
| *Ум-2* | be able to find the equivalent, molar and equivalent mass of simple and complex compounds | *ПР2, ПР26, ПР27* |
| *Ум-3* | be able to experimentally determine the equivalent mass of metal by displacing hydrogen ion from acid | *ПР2, ПР26, ПР27* |
| *Ум-4* | be able to characterize the action of the structure of atoms on the nature of the bond | *ПР2, ПР26, ПР27* |
| *Ум-5* | be able to write the electronic formula of the atom and ion | *ПР2, ПР26, ПР27* |
| *Ум-6* | be able to characterize the properties of the element, based on its place in the periodic table | *ПР2, ПР26, ПР27* |
| *Ум-7* | be able to calculate the concentrations of solutions and recalculate from one method of expressing the concentration to | *ПР2, ПР26, ПР27* |

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| *Ум-8* | be able to determine some parameters of the substance based on the colligative properties of its solution | *ПР2, ПР26, ПР27* |
| *Ум-9* | be able to prepare solutions with a known concentration | *ПР2, ПР3, ПР26, ПР27* |
| *Ум-10* | be able to solve numerical problems on thermochemistry and thermodynamics and determine the direction of the chemical reactions | *ПР2, ПР26, ПР27* |
| *Ум-11* | be able to write ionic equations and calculate $K_{sp}$ | *ПР2, ПР26, ПР27* |
| *Ум-12* | be able to experimentally determine the pH of salt solutions | *ПР2, ПР26, ПР27* |
| *Ум-13* | be able to write ionic and molecular equations of hydrolysis | *ПР2, ПР26, ПР27* |
| *Ум-14* | be able to experimentally determine the influence of the medium on redox processes | *ПР2, ПР26, ПР27* |
| *Ум-15* | be able to plot the dependence of the reaction rate on various factors | *ПР2, ПР26, ПР27* |
| *Ум-16* | be able to balance redox reactions | *ПР2, ПР26, ПР27* |
| *Ум-17* | be able to relate the chemical activity of metals with the values of their standard electrode potentials | *ПР2, ПР26, ПР27* |
| *Ум-18* | be able to analyze the effect of pH on the nature of the reduction of permanganate | *ПР2, ПР26, ПР27* |
| *Ум-19* | be able to write the formulas of complex compounds | *ПР2, ПР26, ПР27* |
| *Ум-20* | be able to experimentally obtain complex compounds with different complexing agents | *ПР2, ПР3, ПР26, ПР27* |
| *Ум-21* | be able to experimentally obtain alkalis and know their properties | *ПР2, ПР3, ПР26, ПР27* |
| *Ум-22* | be able to experimentally confirm the chemical properties of hydrogen and its compounds | *ПР2, ПР3, ПР26, ПР27* |
| *Ум-23* | be able to identify areas of water use | *ПР2, ПР26, ПР27* |
| *Ум-24* | be able to experimentally confirm the chemical properties of alkali metals and their compounds | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *Ум-25* | be able to experimentally confirm the chemical properties of alkaline earth metals and their compounds | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *Ум-26* | be able to experimentally confirm the chemical properties of boron and aluminum and their compounds | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *Ум-27* | be able to experimentally confirm the chemical properties of Carbon and Silicon and their compounds | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *Ум-28* | be able to experimentally confirm the chemical properties of the Germanium subgroup elements and their compounds | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *Ум-29* | be able to experimentally confirm the chemical properties of Nitrogen and its compounds | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *Ум-30* | be able to experimentally confirm the chemical properties of Phosphorus and its compounds | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *Ум-31* | be able to experimentally confirm the chemical properties of the Arsenic subgroup elements and their compounds | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *Ум-32* | be able to experimentally confirm the chemical properties of the elements of the VIA group and their compounds | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *Ум-33* | be able to experimentally confirm the chemical properties of elements VIIA group and their compounds | *ПР2, ПР3, ПР10, ПР26,* |

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| | | *ПР27* |
| *Ум-34* | be able to experimentally confirm the chemical properties of the elements of the IB group and their compounds | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *Ум-35* | be able to experimentally confirm the chemical properties of IIB group elements and their compounds | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *Ум-36* | be able to experimentally confirm the chemical properties of VIB group elements and their compounds | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *Ум-37* | be able to experimentally confirm the chemical properties of VIIB group elements and their compounds | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *Ум-38* | be able to experimentally confirm the chemical properties of elements of the Iron family and their compounds | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *Ум-39* | be able to experimentally check the ability of water to react with metals, oxides and other compounds | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *Ум-40* | be able to compare the properties of ruthenium, osmium, platinum compounds | *ПР2, ПР26, ПР27* |
| *К-1* | ability to apply knowledge in practical situations | *ПР2, ПР26, ПР27* |
| *К-2* | ability to abstract thinking, analysis and synthesis, ability to learn and be modernly trained | *ПР2, ПР26, ПР27* |
| *К-3* | knowledge and understanding of the subject area | *ПР2, ПР26, ПР27* |
| *К-4* | ability to evaluate and ensure the quality of performed work | *ПР2, ПР26, ПР27* |
| *К-5* | ability to organize activities for the preparation of solutions | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *К-6* | ability to organize activities for planning and performing simple chemical experiments | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *К-7* | the ability to predict the chemical properties of an element and its compounds depending on its position in the periodic table | *ПР2, ПР26, ПР27* |
| *АВ-1* | to be responsible for making decisions in difficult conditions | *ПР2, ПР3, ПР10, ПР26, ПР27* |
| *АВ-2* | to be responsible for the timely acquisition of modern knowledge | *ПР2, ПР26, ПР27* |
| *АВ-3* | to be responsible for the quality of work | *ПР2, ПР26, ПР27* |
| *АВ-4* | Independence, responsibility | *ПР2, ПР3, ПР10, ПР26, ПР27* |

**6. Course format and content**

| **Course format** | **Full-time Course** | |
|---|---|---|
| Classes | Hours | Groups |
| Lectures | **30** | |
| Practical | **105** | |
| Seminars | – | |
| Individual | **134** | |

| 7. Topics and content of the course | | | | |
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| **Code of the classes type** | **Topic** | **Content** | **Code of the learning outcomes** | **Professor** |
| П-1/ Л-1/СРС-1 СРС-2, СРС-3 | Atomic-molecular concept. Nomenclature and classification of inorganic compounds. Basic laws of chemistry | Substance. Purity of chemicals. Symbols of degree of purity (classification of substances by purity). Theoretical foundations of substances purification. Physical constants as a way to identify a substance.<br>Atomic-molecular theory. The concept of the atom and its basic characteristics: relative atomic mass, charge and number of the element in the periodic table, chemical symbol. Isotopes. Concept about a molecule, structure of molecules and properties. Relative molecular weight, molar mass of substances.<br>Basic laws of chemistry: the law of conservation of mass, Avogadro's law, ideal gas law. Molar volume of gas. The relationship between the density of gas and its molecular mass.<br>Chemical formulas, their types, formulas according to chemical analysis or chemical reactions equations. Qualitative and quantitative information arising from chemical formulas and equations. Determination of molecular formulas. Chemical equations and chemical reactions. Writing chemical equations, molecular and ionic equations for various types of chemical reactions. Stoichiometry. Calculations using chemical formulas and equations. | *Зн-1, Зн-2, Зн-3, Ум-1, Ум-2, К-1, К-2, К-3, АВ-1, АВ-2, АВ-4* | O.Klenina<br>M.Sulyma<br>O.Roman<br>I.Myrko |
| П-2/ Л-1/ СРС-4 | The concept of equivalent substances. | Chemical equivalent, its definition. Molar mass equivalent. Calculations of molar mass equivalent of simple and complex compounds. The equivalent's law. | *Зн-2, Зн-3, Ум-2, Ум-3, К-1, К-2, К-3, К-4, К-6, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-3/ Л-1, Л-2/, СРС-5, СРС-6, СРС-7 | Structure of atoms. The Periodic law and Periodic table by D. Mendeleev. The nature of chemical bonds and structure of chemical compounds. | The main stages of development theory of atomic structure. Spectra of atoms. Quantum nature of the absorption and emission of energy. De Broglie equation. The nature movement of electrons in the atom.<br>Quantum numbers. The principal quantum number (n). The angular momentum quantum number (l). The magnetic quantum number (ml). The electrons spin quantum number (ms). Atomic orbitals: s-, p- and d-orbitals of an atom. The energies of orbitals. Electron configuration. The Pauli exclusion principle. Hund's rule.<br>The principles and rules that define the sequence of filling atomic orbitals by electrons: the principle of least energy, the Pauli principle, the Hund rule, the rules of Klechkovsky, the rule of symmetry. Electronic and electron-graphic formulas of the atoms of elements and their ions.<br>The periodic law and the periodic table. Development of the periodic table. Periodic classiffication of the elements. The structure of the periodic table of elements: periods, groups, families. Periodic variation in physical properties. Effective nuclear charge. Atomic radius. Ionic radius. Variation of physical properties across a period and within a group. Ionization energy. Electron affiniity. Properties of oxides, hydrides across a period.<br>The mechanism of formation of the chemical bond between atoms. Types of chemical bonds. | *Зн-4, Зн-5, Зн-6, Зн-7, Зн-19, Ум-4, Ум-5, Ум-6, К-1, К-2, К-3, АВ-1, АВ-2, АВ-4* | |

| Code of the classes type | Topic | Content | Code of the learning outcomes | Professor |
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| | | Physical and chemical properties of compounds with covalent, ionic and metallic bond. Experimental characteristics of bonds: energy, length.<br>Covalent bond. Lewis formulas. Coordinate covalent bond. Octet rule. Multiple bonds. Polar covalent bond. Single bond. Double and triple bonds. Electronegativity and oxidation number. Formal charge and Lewis structure. Delocalized bonding. Bond length and bond order. Ionic compounds. Comparison of the properties of covalent and ionic compounds. Hybridization of atomic orbitals. The polar and nonpolar molecules.<br>Metallic bond. Hydrogen bond and its biological role. Hybridization of atomic orbitals. Polar and nonpolar molecules. | | |
| П-4/ Л-3, СРС-8 | The concept of the solution. The ways of expressing the concentration of solutions | The role of solutions in the organism's life. Classification of solutions. Mechanism of dissolution processes. Thermodynamic approach to the process of the dissolution. The solubility of the substances.<br>The solubility of gases in liquids. The dependence of the solubility of gases on the pressure (Henry-Dalton's law), nature of the gas and solvent, temperature. Effect of electrolytes on the solubility of gases (Sechenov's law). Solubility of gases in the blood. Decompression sickness. The solubility of liquids and solids in liquids. The dependence of solubility on temperature and the nature of the solute and solvent. | *Зн-8, Ум-7, К-1, К-2, К-3, К-4, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-5/ Л-3/ СРС-9 | Preparation of a solution of known concentration | ***Solutions used as disinfectants and antiseptics to prevent infection and spread of COVID-19.*** Preparation of solutions of a given quantitative composition Mass percentage of solute. Mass fraction of solute, volume fraction of solute. Molar concentration of solute. Molar concentration of solute equivalent. Molality solution. ***Solutions used as antiseptics for personal hygiene, as well as for disinfection in public and residential premises and buildings. Classification of disinfectants and antiseptics by the main active substances and their concentration in working solutions.*** | *Зн-8, Ум-7, Ум-9, К-1, К-2, К-3, К-4, К-5, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-6/ Л-4/ СРС-10 | Colligative properties of solutions | The concept of colligative properties of solutions. Dependence "solution property - concentration". Raoult's law. Vant' Hoff's law. Osmosis and osmotic pressure. Osmolarity of solutions. Concentration effects of osmotic pressure of electrolyte solutions. Isotonic coefficient. Hypo-, hyper- and isotonic solutions. The role of osmosis and osmotic pressure in biological systems. Plasmolysis, hemolysis, turgor. Cryometry, ebuliometry, osmometry and their application.<br>Cryometry, ebuliometry, osmometry, and their use in biomedical research | *Зн-9, Ум-8, К-1, К-2, К-3, К-4, К-6, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-7/ Л-4/ СРС-11, СРС-12 | The basic terms of chemical thermodynamics.Thermochemistry The direction of the | Heat and work as characteristics of processes.<br>Internal energy and enthalpy of substances. The first law of thermodynamics. Standard conditions and standard enthalpies of formation and combustion of substances. Heat of chemical reactions at constant temperature and pressure. Thermochemical equations, their features and calculations based on thermochemical equations The first law of thermodynamics. Enthalpy. Thermochemical equations. Standard enthalpies of formation and combustion. Hess's law.<br>Spontaneous and non-spontaneous processes. The second law of thermodynamics. Entropy. | *Зн-10, Ум-10, К-1, К-2, К-3, К-4, К-6 АВ-1, АВ-2, АВ-3, АВ-4* | |

| Code of the classes type | Topic | Content | Code of the learning outcomes | Professor |
|---|---|---|---|---|
| | chemical processes. | Thermodynamic potentials: Gibbs' free energy, Helmholtz' free energy. Termodynamical equilibrium conditions. The criteria for the spontaneous processes direction. Tables of standard Gibbs' free energy, their use to determine the direction of the process. | | |
| П-8/ Л-5/ СРС-13, СРС-14 | Rate and mechanisms of chemical reactions. Chemical equilibrium | Average and instantaneous reaction rate. The concept of the mechanism of reactions. Simple and complex reactions.The reaction rate. Concentration affection the reaction rate. The law of mass action for the reaction rate. Rate constant. The reaction order. The reaction mechanism concept and the reaction molecularity. The order and molecularity of the reaction. The equation of the rate constant for the first order reaction<br>The temperatures influence the reaction rate. Van't Hoff's rule.<br>Activation energy. Collision theory. Arrhenius equation. The concept of the transition state theory.<br>Catalysis and catalysts. Features of catalysts. Homogeneous, heterogeneous and microheterogeneous catalysis. Acid-base catalysis. Autocatalysis. The mechanism of catalytical action. Promoters and catalytic poisons.<br>The kinetics of enzymatic reactions. Enzymes as biological catalysts. Enzymes features: selectivity, efficiency, temperature and reaction medium affections. The concept of the enzymes action mechanism.<br>The concept of equilibrium and the equilibrium constant. Quantitative characteristic of chemical equilibrium. Predicting the direction of a reaction.<br>Equilibrium constant and its relationship with the standard Gibbs' energy. Factors that affect chemical equilibrium. Le Chatelier' principle. | *Зн-11, Зн-12, Ум-10, Ум-15, К-1, К-2, К-3, К-4, К-6, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-9/ Л-6/ СРС-15, СРС-16 | The concept of strong and weak electrolytes. The equilibrium in feebly soluble electrolytes solutions. | The concept of strong and weak electrolytes. Theory of strong electrolytes solutions. Properties of solutions of strong electrolytes. Ionic force of a solution. Activity and activity coefficient of ions in solutions of strong electrolytes. Solutions of weak electrolytes. The degree of dissociation. The dependence of the degree of dissociation on concentration (Ostwald dilution law). Dissociation constant.<br>Equilibrium between solution and precipitate of feebly soluble electrolytes. The solubility product constant (Ksp). Condition of formation and dissolving of precipitates. | *Зн-13, Зн-14, Ум-11, К-1, К-2, К-3, К-4, К-6, К-4, К-6, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-10/ Л-6/ СРС-17 | Acids and bases theories. Self-ionization of water. pH | Theories of acids and bases (Arrhenius, Brendsted-Lowry, Lewis). Amphoteric electrolytes.<br>Electrolyte solutions. The degree and the dissociation constant of weak electrolytes. Properties of solutions of strong electrolytes. Water and electrolyte balance - a necessary condition for homeostasis. Dissociation of water. Ionic product of water. pH and pOH. | *Зн-14, Ум-12, К-1, К-2, К-3, К-4, К-6, К-4, К-6, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-11/ Л-6/ | Protolytic | Protolytic processes and their directionality. Hydrolysis of cations, and anions. Degree and constant | *Зн-15, Ум-15, К-* | |

| Code of the classes type | Topic | Content | Code of the learning outcomes | Professor |
|---|---|---|---|---|
| CPC-18 | processes | of hydrolysis. The shifting of protolytic reactions equilibrium. Role of protolytic reactions in the metabolism of medicines and their analysis. Chemical incompatibility of medicinal. | *1, К-2, К-3, К-4, К-6, К-4, К-6, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-12/ Л-7/ CPC-19 | Reactions with electrons transferring. Experimental study of redox reactions | Electronic theory of redox reactions. Oxidation-reduction properties of elements and their compounds, depending on their position in the periodic system. The oxidation number of the atoms of elements in compounds and rules of its determination. Redox duality.<br>The concept of the affect of the medium on the nature of products and the direction of the redox reactions. Definition of the redox processes direction, oxidation-reduction potentials and the standard Gibbs energy in the oxidation-reduction processes. Use of the redox reactions in chemical analysis.<br>The role of oxidation-reduction processes in metabolism | *Зн-16, Зн-17, Ум-14, Ум-16, Ум-17, Ум-18, К-1, К-2, К-3, К-4, К-6, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-13/ Л-7/ CPC-20 | Coordination compounds. Reactions of coordination compounds formation. Experimental study of complex compounds | Complex formation reactions. Werner coordination theory and modern understanding of the structure of complex compounds. The concept about complexing agent (central ion). The dissociation constant Kd of a complex ion. Nature, coordination number, hybridization of central atom orbitals. The concept about ligands. Denticity of ligands. The internal and external sphere of the coordination compounds. Geometry of the complex ion. The nature of the chemical bond in complex compounds. Spectra and magnetic properties of coordination compounds. Classification of compounds according to the charge on the inner sphere and the nature of ligands.<br>Classification, nomenclature and isomerism of complex compounds. Complex acids, bases, salts.<br>Metal carbonyls, chelate and macrocyclic coordination complexes. Cluster and clathrate compounds.<br>Conditions for the complexation reactions. Formation and dissociation of coordinatiom compounds in the solutions. Stability constants and instability constants of complex ions. The biological role.<br>Formation of complexes between inorganic and biological compounds. Metal-ligand homeostasis.<br>Chemical basis for the use of the complex compounds in pharmaceutical analysis and medicine.<br>Metal enzymes, the concept of the structure of their active centers. Formation of complexes between inorganic and biological compounds. | *Зн-18, Зн-20, Ум-19, Ум-20, К-1, К-2, К-3, К-4, К-6, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-14/ Л-8/ CPC-21, CPC-22, CPC-23, CPC-24 | Chemical elements and their classification. A human and biosphere. General characteristics of s-elements. | The concept of the chemical elements; their classification by origin, chemical properties, the structure of the outer energy level, spreading in nature and importance for living organism. Classification of bioelements; their content in human body. Connection between physico-chemical parameters of the elements and their position in the periodic system and the content in the body.<br>V. Vernadsky's doctrine about biosphere and biogeochemistry. The concept of migration of chemical elements. Relationship between endemic diseases and features of biogeochemical provinces.<br>A human and biosphere. Noosphere. Technological progress and ecology. General characteristics of Hydrogen. Position in the periodic table of elements. Reactions with oxygen, halogens, metal | *Зн-21, Зн-22, Зн-23, Ум-21, Ум-22, Ум-23, Ум-24, Ум-39, Зн-24, Зн-25, К-1, К-2, К-3, К-4, К-6, К-7, АВ-1, АВ-2, АВ-3, АВ-4* | |

| Code of the classes type | Topic | Content | Code of the learning outcomes | Professor |
|---|---|---|---|---|
| | Hydrogen and its compounds. s-Elements of the IA group. Alkali metals. | oxides. Characteristics and reactivity of hydrogen compounds with other common elements: oxygen, nitrogen, carbon, sulfur. Ions of hydrogen, hydronium and ammonium.<br>Water as an important compound of hydrogen. Its physical and chemical properties. Aquacomplexes and crystall hydrates. Distilled and non-pyrogenic water - preparation and use in pharmacy. Natural water, pollution of water, mineral water.<br>Hydrogen peroxide. The structure of the molecule. Methods of obtaining. Acid-base and redox properties of hydrogen peroxide, use in medicine and pharmacy..<br>General characteristics of IA group elements. Occurrence in nature. Biological role of s-elements in mineral balance of a human body. Macroelements.<br>The difference between lithium and other alkali metals. Binary compounds of alkali metals: hydrides, oxides, peroxides, superoxide.<br>Alkali metals hydroxides, salts, their properties and use. Use of lithium, sodium and potassium compounds in medicine. | | |
| П-15/ Л-9/ СРС-25 | s-elements of the IIA group. Beryllium, Magnesium, and Alkaline earth metals. | General characteristics of s-elements of IIA group. Reducing properties of elements. Comparison of beryllium, magnesium and calcium properties. Reactions of simple substances with water, acids and bases solutions.<br>Beryllium. Chemical properties. sp-hybridization of atomic orbitals of beryllium. Beryllium oxide and hydroxide, their amphoteric properties. Aqua- and hydroxocomplexes of beryllium. Solubility and hydrolysis of beryllium salts.<br>Magnesium. Magnesium oxide and hydroxide. Solubility and hydrolysis of magnesium salts. $Mg^{2+}$ ion as a complex formation agent. Chlorophyll.<br>Alkaline earth metals. General characteristics. Physical properties and occurrence. Chemical properties. Basic oxides and hydroxides of the alkaline earth metals. Solubility in water. Reactions of identification of $Mg^{2+}$, $Ca^{2}$+, $Sr^{2+}$, $Ba^{2+}$ ions. Hardness of water. Methods of softening.<br>Calcium compounds in the bone tissue. The toxic action of beryllium and barium. The biological role of calcium and magnesium. Uses of magnesium, calcium and barium compounds in medicine and pharmacy. | *Зн-22, Зн-26, Зн-27, Ум-21, Ум-25, К-1, К-2, К-3, К-4, К-6, К-7, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-16/ Л-10/ СРС-26 | p-elements of the IIIA grup. Boron and Alluminium | General characteristics of IIIA group elements. Electron deficiency and its influence on the properties of elements and their compounds. General characteristics of Boron. Simple substance and its chemical activity. Borides. Compounds with hydrogen (boranes). Boron halogenides, hydrolysis and complex formation. Boron oxide and boric acids. Equilibrium in aqueous solution. Sodium tetraborate. Boric acid esthers. Organoaluminium compounds of boron. The biological role of boron. Antiseptic properties of boric acid and its salts.<br>Aluminium. General characteristics. Simple substance and its chemical activity. Amphoteric properties of aluminum and its oxide and hydroxide. Aluminate. Aluminum ion as a complexing agent. Anhydrous aluminum salts and crystalline hydrates. Halides. Aluminum hydride. Uses of | *Зн-22, Зн-28, Зн-29, Ум-26, К-1, К-2, К-3, К-4, К-6, К-7, АВ-1, АВ-2, АВ-3, АВ-4* | |

| Code of the classes type | Topic | Content | Code of the learning outcomes | Professor |
|---|---|---|---|---|
| | | aluminum and its compounds in medicine and pharmacy. | | |
| П-17/ Л-10/ СРС-27, СРС-28, СРС-29, | *p*-elements of the IVA group. Carbon and Silicon. *p*-elements of the IVA group. Germanium family elements (Germanium, Tin, and Lead) | General characteristic of IVA group elements. Carbon allotropes. Hybridisation. Carbon as the basis of all organic molecules. Biological role of carbon. Physical and chemical properties of its inorganic compounds. Activated charcoal.<br>Compounds of carbon with negative value of the oxidation state. Carbides, their properties and use.<br>Compounds of carbon(II). Carbon oxide(II), its acid-base and redox properties. Carbon oxide(II) as a ligand.<br>Hydrogen cyanide. Toxic action.<br>Carbon dioxide (IV). Equlibrium in water solution. Carbonic acid, carbonates and hydrogencarbonates. Hydrolysis and thermolysis of carbonic acid salts.<br>Compounds of carbon with halogens and sulfur. Carbon chloride (IV). Carbon disulfide and tiocarbonates. Thiocyanates and cyanates. Physical and chemical properties<br>Silicon. General characteristic. The biological role. Silicides. Compounds with hydrogen (silane), hydrolysis of silane. Silicon tetrafluoride and tetrachloride, their hydrolysis. Hexafluorosilicates.<br>Compounds of silicon with oxygen, silicon dioxide(IV) (silica). Glass, its properties and stability. Silicic acids. Silicates, their solubility and hydrolysis. Silicone polymers. The use of silicon compounds in medicine<br>Silicic acids. Silicates, their solubility and hydrolysis. Natural silicates and aluminosilicates. Zeolites. Organosilicon compounds. Silicones and siloxanes.<br>Genaral characteristics of Germanium, Lead and Tin. Compounds with hydrogen. Compounds with halogens $EF_2$ and $EF_4$, their behavior in aqueous solutions. Oxides. Amphoteric properties of oxides. Stannic acid. Stannites (Na2SnO2) and stannates (Na2SnO3). in and lead hydroxocomplexes. Reducing properties of tin (II) compounds. Lead (IV) oxide as a strong oxidizing agent. Soluble and insoluble salts of tin and lead. Redox reactions in solutions. The toxic effects of Pb compounds.<br>Uses of lead compounds (lead (II) oxide and lead acetate) in medicine and pharmacy. Uses of tin and lead compounds in the pharmaceuticals analysis. Toxic effect of lead organic compounds. | *Зн-22, Зн-30, Ум-27, Ум-28, К-1, К-2, К-3, К-4, К-6, К-7, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-18/ Л-11/ СРС-30 | *p*-elements of the VA group. Compounds of Nitrogen in negative oxidation state. *p*- elements of the VA group. | General characteristics of the elements of VA group. Nitrogen, phosphorus, arsenic. Their biological role in the nature and human body.<br>Nitrogen. General characteristics. Compounds with different oxidation states. Nitrogen as a simple substance. The reasons for its low chemical activity. Nitrogen molecule as a ligand. Compounds with negative oxidation states. Nitrides. Acid-base and redox properties of ammonia. Amides. Ammonia ion and its salts, acid-base properties, thermal decomposition. Acid-base and redox properties of hydrazine and hydroxylamine.<br>Compounds of nitrogen with a positive oxidation state. Nitrogen oxides. Methods of preparation. | *Зн-22, Зн-31, Ум-29, К-1, К-2, К-3, К-4, К-6, К-7, АВ-1, АВ-2, АВ-3, АВ-4* | |

| Code of the classes type | Topic | Content | Code of the learning outcomes | Professor |
|---|---|---|---|---|
| | Compounds of Nitrogen in positive oxidation state. | Acid-base and redox properties. Nitrous acid and nitrites. Nitric acid and nitrates, acid-base and redox properties. Thermal decomposition. "Royal water". Toxic action of nitrogen oxides and nitrates. | | |
| П-19/ Л-11/ СРС-31 | *p*- elements of the VA group. Phosphorus and its compounds | Phosphorus. General characteristics. Allotropic modifications of phosphorus. Chemical activity of phosphorous compounds. Phosphides and phosphine. The comparison of the phosphides and phosphine with the corresponding compounds of nitrogen.<br>Phosphorus compounds with positive oxidation states. Hydrolysis of the halides. Oxides of phosphorous.<br>Ortophosphorous and hypophosphorous acids, structure of molecules, acid-base and redox properties. Phosphoric acid and its ions. Dihydrogenphosphates, hydrogenphosphates and phosphates. Pyrophosphoric acid. Metaphosphoric acid.<br>Reaction of phosphate ion identification. The biological role of phosphorus and its compounds. | *Зн-22, Зн-31, Ум-30, К-1, К-2, К-3, К-4, К-6, К-7, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-20/ Л-12/ СРС-32 | *p*-elements of the VA group. Arsenic family elements (Arsenic, Antimony, Bismuth) | The elements of Arsenic subgroup. General characteristics. Compounds of arsenic, antimony and bismuth with hydrogen in comparison with ammonia and phosphine.<br>Detection of arsenic and antimony by the Marsh test.<br>Compounds with positive oxidation states. Oxides and hydroxides of elements and their acid-base and redox properties. Arsenites and arsenates. Their acid-base and redox properties. Salts of antimony and bismuth. Oxosalts formation. Bismuthates and their stability.<br>Application in medicine and pharmacy of oxides and salts of arsenic, antimony and bismuth and compounds p-elements of VA group. | *Зн-22, Зн-31, Ум-31, К-1, К-2, К-3, К-4, К-6, К-7, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-21/ Л-12, Л-13/ СРС-33, СРС-34 | p-elements of the VIA group. Oxygen, Sulfur, Selenium, Tellurium | General characteristics of the elements of VIA group. Oxygen. General characteristics, occurence in nature. Features of the electronic structure of oxygen molecules.<br>Stereochemistry and nature of bonds in molecule of Ozone. Binary compounds: oxides, peroxides, superoxides, ozonides. Compound of oxygen with fluorine.<br>The biological role of oxygen. Use of oxygen and ozone in medicine and pharmacy.<br>General characteristics and biological role of Sulphur. Compounds of sulfur with negative oxidation states. Acid-base and redox properties of hydrogen sulfide. Metal and non-metal sulphides, their water solubility and hydrolysis. Identification reaction of sulfide-ion.<br>Sulfur (IV) compounds - oxide, sulfurous acid, sulfites and hydrogensulfites, their acid-base and redox properties. The interaction of sulfites with sulfur. Identification reaction of sulfite-ion.<br>Properties of thiosulfate: reactions with acids, oxidizing agents (chlorine, iodine), metal cations, complexation reactions. Identification reaction of thiosulfate-ion.<br>Sulfur (VI) compounds – oxide, hexafluoride, dioxochloride, sulfuric acid, sulfates. Theis acid-base and redox properties. Oleum. Disulfuric acid. Chlorosulfonic acid.<br>The use of sulfur compounds in medicine, pharmacy and pharmaceutical analysis. Selenium and | *Зн-22, Зн-32, Зн-33, Ум-32, К-1, К-2, К-3, К-4, К-6, К-7, АВ-1, АВ-2, АВ-3, АВ-4* | |

| Code of the classes type | Topic | Content | Code of the learning outcomes | Professor |
|---|---|---|---|---|
| | | tellurium. General characteristics. Acid-base and redox properties of the compounds. The biological role of selenium. | | |
| П-22/ Л-13/ СРС-35 | *p*-elements of the VIIA group. Halogens | General characteristics of the halogens. Properties of fluorine as the most electronegative element. Simple substances, their chemical activity.<br>Compounds of halogens with hydrogen. Solubility in water. Acid-base and red-ox properties. Ionic and covalent halides. Halide ions as ligands in complex compounds. Reactions of identification of halide ions.<br>Halogens with positive oxidation states. Compounds with oxygen. Reactions of halogens with water and aqueous solutions of alkalis. Oxoacids of halogen and their salts. Chlorate, bromates and iodates. The biological role of chlorine, fluorine, bromine and iodine.<br>The bactericidal action of chlorine and iodine. The use of bleach, iodine and fluoride, chloride, bromide, iodide for disinfecting and sterilizing. | *Зн-22, Зн-34, Зн-35, Ум-33, К-1, К-2, К-3, К-4, К-6, К-7, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-23/ Л-14/ СРС-37, СРС-38, | General characteristic of d-elements. *d*-elements of the IB group. Copper, Silver, Gold | Types of chemical reactions with their participation.<br>General characteristics of d-elements. Characteristic features of d-elements: oxidation, complex formation, colored cationic and anionic complexes involved in the redox reactions. Change of acid-base and redox properties of compounds with changing oxidation state.<br>Secondary periodicity in families of d-elements, Lanthanide contraction. Lanthanides and actinides as analogues of d-elements of the IIIB group. The reasons for the similarity of f-elements, valence electrons. The concept of biogenic trace elements and their content in the body.<br>General characteristics of the group IB elements. Physical and chemical properties of simple substances. Reactions with acids, oxygen, halogens.<br>Compounds of copper (I) and copper (II), their acid-base and red-ox properties, ability to form complexes. Complex compounds of copper (II) with ammonia, amino acids.<br>Oxide and halides of copper (I). Complex compounds of copper (I) with chlorides and ammonia. The use of copper compounds in medicine and pharmacy.<br>Silver compounds, their acid-base and red-ox properties. The ability to form complexes with halide-ions, ammonia, thiosulfate ions. The antimicrobial properties of $Ag^+$ ions. The use of silver compounds in medicine and pharmaceutical analysis.<br>Gold. Oxidation of gold by oxygen in the presence of cyanide ions. Attitude of gold to "aqua regia". Compounds of gold (I), gold (III) and their acid-base and red-ox properties, ability to form complexes. The use of gold and its compounds in medicine and pharmacy. | *Зн-22, Зн-37, Зн-38, Ум-34, К-1, К-2, К-3, К-4, К-6, К-7, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-24/ Л-14/ СРС-39 | *d*-elements of the IIB group. Zinc, Cadmium, Mercury | General characteristics of the elements of group IIB. Physical and chemical properties of simple substances.<br>Zinc. General characteristics. Chemical activity of simple substance. Acid-base and redox characteristics of zinc compounds. Zinc salts, their solubility and hydrolysis. Complex compounds of zinc with ammonia, water and hydroxide ions. Zinc-containing enzymes. Use of zinc compounds in | *Зн-22, Зн-37, Зн-39, Ум-35, К-1, К-2, К-3, К-4, К-6, К-7, АВ-1, АВ-2, АВ-3, АВ-4* | |

| Code of the classes type | Topic | Content | Code of the learning outcomes | Professor |
|---|---|---|---|---|
| | | medicine and pharmacy.<br>Cadmium and its compounds compared to similar compounds of zinc.<br>Mercury. General characteristics, properties that differ from zinc and cadmium. Reaction of mercury with sulfur, nitric acid and iron (III) chloride. Mercury nitrates. Hydrolysis. Basic salts. Mercury (I) and mercury(II) compounds. Acid-base and redox characteristics, the ability to form complexes. Calomel and mercury chloride, their reaction with ammonia. The toxic effects of cadmium and mercury compounds. Use of mercury in medicine and pharmacy. | | |
| П-25/ Л-14/ СРС-41 | *d*-elements of the VIB group. Cromium family | General characteristics of d-elements of VI group. Chromium compounds in nature. Simple substance and its chemical activity. Chromium carbonyl.<br>Chromium (II) compounds and their acid-base and redox characteristics. Chromium (III) compounds and their acid-base and redox characteristics. The ability to form complexes. Identification reaction of $Cr^{3+}$ ion. Chromium (VI) compounds – oxide and dichromic acid. Chromates and dichromates, their acid-base and redox properties. Chromium peroxide.<br>Molybdenum and Tungsten, general characteristics. The ability to form iso-poly- and hetero-polyacids, redox properties of the compounds. Biological role of chromium and molybdenum. Use of chromium, molybdenum and tungsten compounds in pharmaceutical analysis and medicine. | *Зн-22, Зн-37, Зн-41, Ум-36, К-1, К-2, К-3, К-4, К-6, К-7, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-26/ Л-14/ СРС-42 | *d*-elements of the VIIB group. Manganese elements family. | General characteristics of manganese. Chemical activity of simple substance. The ability to form coordination compounds (formation of carbonyles).<br>Manganese (II) and manganese (III): acid-base and red-ox properties, coordinaton compounds formation. Determinaton of $Mn^{2+}$ ion. Manganese (IV) oxide, acid-base and red-ox properties, effect of pH on the redox properties. Manganese (VI) compounds. Manganese (VII) compounds: acidic oxide, permanganic acid, its salts, red-ox properties, oxidation of organic compounds, thermal decomposition. The biological role of manganese. Application of potassium permanganate in pharmaceutical analysis and as antiseptics solutions. | *Зн-22, Зн-37, Зн-42, Ум-37, К-1, К-2, К-3, К-4, К-6, К-7, АВ-1, АВ-2, АВ-3, АВ-4* | |
| П-27/ Л-15/ СРС-43, СРС-44, | *d*-elements of the VIIIB group. Iron and its compounds. Cobalt and Nickel compounds. Platinum metals. | General characteristic of iron, its ionic state, coordination number. Occurrence in nature. Chemical activity of iron. Complex formation ability. Corrosion of iron products.<br>The compounds of iron (II) - acid-base and red-ox properties. Complex compounds with cyanide and thiocyanate ions, porphyrins. Biological role of hemoglobin. Iron (III) compounds. Iron (III) oxide and hydroxide. Iron (III) chloride and its hydrolysis. Complex compounds of iron (III). Determination of $Fe^{2+}$ and $Fe^{3+}$ cations. Iron (VI) compounds. Preparation of ferrates and their oxidizing properties.<br>Application of iron and its compounds in medicine.<br>Cobalt and Nickel. Valence states. Chemical activity. The most important compounds of cobalt (II), cobalt (III) and nickel (II). Characteristics of redox properties. Hydrolysis of cobalt (II) and nickel (II) salts. Complex compounds with cyanide, thiocyanate and fluoride ions. Aqua-complexes. Vitamine B12. Reactions of $Co^{2+}$ and $Ni^{2+}$ cations identification. Chugaev elimination. | *Зн-22, Зн-37, Зн-43, Ум-38, К-1, К-2, К-3, К-4, К-6, К-7, АВ-1, АВ-2, АВ-3, АВ-4* | |

| Code of the classes type | Topic | Content | Code of the learning outcomes | Professor |
|---|---|---|---|---|
| | | The biological significance and chemical basis of application of cobalt and nickel compounds in medicine and pharmacy.<br>Platinum metals, general characteristics of simple substances and their interaction with acids. Physical properties and applications of platinum metals. Complex compounds of platinum (II) and platinum (IV), coordination numbers, structure, oxidation reactions, reduction reactions and replacement. Oxides of osmium (VIII) and ruthenium (III). Chemical basis of application of platinum group metals compounds in medicine | | |
| CPC-36 | *p*-elements of the VIIIA group. Noble gases | General characteristics of p-elements of the VIIIA group. Features of the structure of molecules. Physical and chemical properties. The relativity of the concept of "noble gases". The compounds of inert gases with fluorine. Features in the structure and properties of helium atom. The use of noble gases in medicine. | *Зн-36, К-2, К-3, К7, АВ-2, ФВ-4* | |
| CPC-40 | *d*-elements of the IIIB – VB groups of the periodic table. Titanium, Vanadium. Lanthanides | *d*- elements of the IIIB group (scandium subgroup). General characteristics, similarities and differences of elements of IIA group. The biological role of scandium, its chemical properties.<br>*f*-element as analogues of d-elements of the IIIB group, similarities and differences. The use of cerium(IV) compounds in analytical chemistry. d-elements IVB and VB groups. General characteristics. Chemical basis of a simple substances and compounds of titanium, niobium, tantalum and vanadium in medicine and pharmacy. | *Зн-40, К-2, К-3, К7, АВ-2, ФВ-4* | |
| CPC-45 | *d*- elements of the VIIIB group. Platinum metals. | Platinum metals, general characteristics of simple substances and their interaction with acids. Physical properties and applications of platinum metals. Complex compounds of platinum (II) and platinum (IV), coordination numbers, structure, oxidation reactions, reduction reactions and replacement. Oxides of osmium (VIII) and ruthenium (III). Chemical basis of application of platinum group metals compounds in medicine | *Зн-44, Ум-40, К-2, К-3, К7, АВ-2, ФВ-4* | |

## 8. Verification of results

### The current control

*Is realized during the practical classes and aims at checking the learning of educational material.*
*The form of the current control assessment during the classes is defined by syllabus of discipline. Forms of current educational activities assessment are standardized and include the control of theoretical and practical training. The 4-point (traditional) scale is used in evaluating the learning of each topic for current educational activity taking into account the approved evaluation criteria.*

| Learning outcome code | Code of classes type | The method of learning outcomes verification | Criteria of evaluation |
|---|---|---|---|
| *Зн-1, Зн-2, Зн-3, Зн-4, Зн-5, Зн-6, Зн-7, Зн-8, Зн-9, Зн-10, Зн-11, Зн-12, Зн-13, Зн-14, Зн-15, Зн-16, Зн-17, Зн-18, Зн-19, Зн-20, Зн-21, Зн-22, Зн-23, Зн-24, Зн-25, Зн-26,* | *П-1/ Л-1/СРС-1 СРС-2, СРС-3,П-2/ Л-1/ СРС-4,П-3/ Л-1, Л-2/, СРС-5, СРС-6, СРС-7,П-4/ Л-3, СРС-8,П-5/ Л-3/ СРС-9,П-6/ Л-4/ СРС-10,П-7/ Л-4/ СРС-11, СРС-12,П-8/ Л-5/ СРС-13, СРС-1,П-9/ Л-6/ СРС-15, СРС-16,П-10/ Л-6/ СРС-17,П-11/ Л-6/ СРС-18,П-12/ Л-* | The current control is a regular check of educational trained achievements, spent by the teacher on current employment according to syllabus of the discipline.<br>It is performed at each practice class according to specific objectives. Theoretical | The minimum number of points that a student must gain for the crediting the theoretical part is 9 points |

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| *Зн-27, Зн-28, Зн-29, Зн-30, Зн-31, Зн-32, Зн-33, Зн-34, Зн-35, Зн-36, Зн-37, Зн-38, Зн-39, Зн-40, Зн-41, Зн-42, Зн-43, Зн-44, Ум-2, Ум-4, Ум-5, Ум-6, Ум-7, Ум-8, Ум-10, Ум-11, Ум-13, Ум-16, Ум-17, Ум-18, Ум-19, Ум-40, К-1, К-2, К-3, К-7, АВ-2, АВ-4* | *7/ СРС-19,П-13/ Л-7/ СРС-20,П-14/ Л-8/ СРС-21, СРС-22, СРС-23, СРС-24,П-15/ Л-9/ СРС-25,П-16/ Л-10/ СРС-26,П-17/ Л-10/ СРС-27, СРС-28, СРС-29,П-18/ Л-11/ СРС-30,П-19/ Л-11/ СРС-31,П-20/ Л-12/ СРС-32,П-21/ Л-12, Л-13/ СРС-33, СРС-34,П-22/ Л-13/ СРС-35,П-23/ Л-14/ СРС-37, СРС-38,,П-24/ Л-14/ СРС-39,П-25/ Л-14/ СРС-41,П-26/ Л-14/ СРС-42,П-27/ Л-15/ СРС-43, СРС-44* | students' self-preparation control is performed in writing by answering 18 multiple choice questions in the form one-of-five, the correct answer to each is estimated at 1 point, and two numerical problems, the correct solving being estimated at 2 points. | |
| *Ум-1, Ум-2, Ум-3, Ум-4, Ум-5, Ум-6, Ум-7, Ум-8, Ум-9, Ум-10, Ум-11, Ум-12, Ум-13, Ум-14, Ум-15, Ум-16, Ум-17, Ум-18, Ум-19, Ум-20, Ум-21, Ум-22, Ум-24, Ум-25, Ум-26, Ум-27, Ум-28, Ум-29, Ум-30, Ум-31, Ум-32, Ум-33, Ум-34, Ум-35, Ум-36, Ум-37, Ум-38, Ум-39, Ум-40, К-1, К-2, К-3, К-4, К-5, К-6, К-7, АВ-1, АВ-2, АВ-3, АВ-4,* | *П-1/ Л-1/СРС-1 СРС-2, СРС-3,П-2/ Л-1/ СРС-4,П-3/ Л-1, Л-2/, СРС-5, СРС-6, СРС-7,П-4/ Л-3, СРС-8,П-5/ Л-3/ СРС-9,П-6/ Л-4/ СРС-10,П-7/ Л-4/ СРС-11, СРС-12,П-8/ Л-5/ СРС-13, СРС-1,П-9/ Л-6/ СРС-15, СРС-16,П-10/ Л-6/ СРС-17,П-11/ Л-6/ СРС-18,П-12/ Л-7/ СРС-19,П-13/ Л-7/ СРС-20,П-14/ Л-8/ СРС-21, СРС-22, СРС-23, СРС-24,П-15/ Л-9/ СРС-25,П-16/ Л-10/ СРС-26,П-17/ Л-10/ СРС-27, СРС-28, СРС-29,П-18/ Л-11/ СРС-30,П-19/ Л-11/ СРС-31,П-20/ Л-12/ СРС-32,П-21/ Л-12, Л-13/ СРС-33, СРС-34,П-22/ Л-13/ СРС-35,П-23/ Л-14/ СРС-37, СРС-38,,П-24/ Л-14/ СРС-39,П-25/ Л-14/ СРС-41,П-26/ Л-14/ СРС-42,П-27/ Л-15/ СРС-43, СРС-44* | The practical skills gained and the laboratory experiments carrying out assessment is performed after the laboratory work fulfilling by assessing the quality and fullness of its performance, the ability to interpret the obtained results. For the practical part of the lesson the student can get:<br>- 4 points if laboratory work is completely fulfilled and the student correctly explains the experiments interpret the results and make conclusions;<br>- 2 points if the laboratory work is done with some errors, the student can not fully explain and summarize the obtained results;<br>- 0 points if the laboratory work is not performed or the student can not explain and summarize the obtained results. | The minimal number of points – 2 |

| **Final control** | | |
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| General evaluation system | The maximal assessment of current progress in a semester makes 60 % from a final assessment of knowledge on discipline, and the maximal assessment of examination makes 40 % from a final assessment of knowledge on discipline. | |
| Grading scales | Traditional 4-point scale, multi-point (200-point) scale, ECTS rating scale. | |
| Conditions of admission to the final control | The student attended all practical classes and received at least 72 points for current performance. | |
| **Exam evaluation criteria** | | |
| Exam | The final control is carried out in the standardized form and includes the theoretical and practical skills assessment.<br>It should be performed in writing as 66 multiple choice questions (1 point for each correct answer) and 7 numerical problems (2 points for each in the | *Stage I evaluation criteria*<br>Maximum quantity of points<br>– 66 points (1 point for each MCQ task);<br>*Stage II evaluation criteria:* |

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| | case of being solved correctly).<br>Final control consists of the following stages:<br>I stage - answer to test questions in the multiple choice format one-of-five.<br>The student meets the test package. Each package contains 66 multiple choice format tests for each thematic module, and is rated at 1 score point for each correct answer.<br>II stage - answer to 7 situational tasks (practical skills assessment). Each correct answer is assessed by 2 score points. | II stage – solving of 7 situational problems.<br>Maximum quantity of points<br>– 14 points (2 points for one problem).<br>*Maximum quantity of points, which the student can collect on the exam makes 80 points.*<br>*Minimum quantity of points on the exam – not less than 50.* |

***The highest possible score points*** which a student can gain for the current educational activity for the semester for admission to the exam is 120 points.
***Minimal number of score points*** which a student must gain for current educational activity for the semester for admission to the exam is 72 points.
***Calculation of the points number*** is based on grades gained by student under the traditional scale (by calculation of the arithmetic mean (*AM*) rounded to two decimal places). The resulting value is converted into points by multi-points scale as follows:

$$x = \frac{\text{CA} \times 120}{5}$$

## 9. Course policy

The policy of the course is determined by the system of requirements for the student in the study of the discipline "General and Inorganic Chemistry" and is based on the:
Regulations of the educational activity (https://cutt.ly/3ySk64r);
Regulations of the evaluation criteria (https://cutt.ly/lySlyw0);
Regulations of the academic integrity (https://cutt.ly/EySkNHu)

## 10. Recommended literature

*Required course textbooks:*

1. General and inorganic chemistry / Levitin Ye.Ya. Vedernikova I.A. – Kharkiv: Publishing House of NUPh: Golden Pages, 2009. – 360 p.
2. Raymond Chang. Chemistry (6th Edition). – WCB/McGraw-Hill. – 1998. – 995 p.
3. John McMurry, Robert C. Fay. Chemistry (3rd Edition). – Prentice Hall. – 2001. – 1067 p.
4. David E. Goldberg. Fundamentals of Chemistry (2nd Edition). – WCB/McGraw-Hill. – 1998. – 561 p.

*Additional books:*

1. Rodney J. Sime Physical Chemistry. Methods. Techniques. Experiments. – Saunders College Publishing. – 1990. – 806 p.
2. John McMurry, Robert C. Fay. Chemistry (3rd Edition). – Prentice Hall. – 2001. – 1067 p.
3. David E. Goldberg. Fundamentals of Chemistry (2nd Edition). – WCB/McGraw-Hill. – 1998. – 561 p.
4. Theodore L. Brown, H.Eugene LeMay, Bruce E. Bursten. Chemistry. The Central Science. – Prentice Hall. – 2000. – 1017 p.
5. John Olmsted III, Gregory M. Williams. Chemistry. The Molecular Science. – Mosby. – 1994. – 977 p.

## 11. Equipment, material, technical and software support of the discipline

**Methodological support**
-Working program of the discipline;
- Multimedia support of lectures
- Lecture thesis from the discipline;
- Methodical recommendations for teachers;
- Educational platform Misa;

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| - Methodical recommendations for practical classes for students;<br>- Methodical manual for students' independent work;<br>- Test and control tasks for practical classes;<br>- Questions and tasks for final control (exam).<br>The department is provided with rooms for practical classes and control activities on the discipline in small groups. Laboratories are equipped with the necessary chemical utensils, reagents, devices. |
| **12. Additional Information** |
| Responsible for the educational process at the department – Associate Professor Volodymyr Rogovyk, rohovyk@i.ua.<br>There is a scientific students' association at the department.<br>During the lectures and practical classes students must have laboratory coats and hats.<br>Practical classes are held in the classrooms of the department at the address: 52 Pekarska street, 2nd floor and 3a Shimzeriv street, Theoretical building, 4th floor.<br>Department website: https://cutt.ly/VyLt4BL. |

The Syllabus was developed by:

V.V. Ogurtsov, PhD in Pharmacy, Assoc.Prof. _____ _____

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Head of the Department

I.V. Drapak, DSc, PhD, Professor _____ _____