SYLLABUS

1. General information on the course

Full course name	Medical Chemisrty
Full official name of a higher education institution	Sumy State University
Full name of a structural unit	Faculty of Technical Systems and Energy Efficient Technologies. Department of Theoretical and Applied Chemistry
Author(s)	Yanovska Hanna Oleksandrivna, Vorobiova Inessa Hennadiivna, Litsman Yuliia Volodymyrivna
Cycle/higher education level	The Second Level Of Higher Education, National Qualifications Framework Of Ukraine – The 7th Level, QF-LLL – The 7th Level, FQ-EHEA – The Second Cycle
Semester	16 weeks during 1-st semester
Workload	The discipline contains 4 credits. ECTS, 120 hours., among them are 40 hours is contact work with teacher (8 h. lectures,32 practical classes)
Language(s)	English

2. Place in the study programme

Relation to curriculum	Compulsory course available for study programme "Medicine"
Prerequisites	Study of disciplines of natural-mathematical cycle according to the program of secondary school
Additional requirements	There are no specific requirements
Restrictions	There are no specific requirements

3. Aims of the course

The aim of the discipline is to achieve students system of knowledge about a holistic physico-chemical approach to the study of the organism life processes and the ability to evaluate the chemical properties and transformations of substances in the life of the organism.

4. Contents

Module 1. CHEMISTRY OF BIOGENIC ELEMENTS. COMPLEX FORMATION IN BIOLOGICAL SYSTEMS. THERMODYNAMIC AND KINETIC REGULARITIES OF CHEMICAL PROCESSES

Topic 1 Biogenic elements; biological role, application in medicine

General information about biogenic elements. Qualitative and quantitative content of biogenic elements in the human body. Macro elements, microelements and impurities. Organogens. The concept of Vernadskys theory of the biosphere and the role of biogenic elements for living matter (living organisms). The relationship between the content of biogenic elements in the human body and their content in the environment. Endemic diseases, their connection with the features of biogeochemical provinces (areas with natural deficiency or excess of certain chemical elements in the lithosphere). Problems of pollution and purification of the biosphere from toxic chemical compounds of man-made origin. Electronic structure and electronegativity of s– and p– elements. Typical chemical properties of s– and p– elements and their compounds (reactions without changing the oxidation state). The relationship between the location of s– and p– elements in the periodic table and their content in the body. Application in medicine. Toxic effect of compounds. Qualitative reactions on CO32-, SO42-, NO2-, S2O32- ions Metals of life. Electronic structure and electronegativity of d-elements. Typical chemical properties of d-elements and their compounds (reactions with changing the degree of oxidation, complexation). Biological role. Application in medicine. Toxic effect of d-elements and their compounds. Qualitative reactions on ions MnO4-, Fe3 +, Cu2 +, Ag

Topic 2 Complex formation in biological systems

Complexation reactions. A. Werner's coordination theory and modern ideas about the structure of complex compounds. The concept of complexing agent (central ion). Nature, coordination number, hybridization of complexing orbitals. The concept of ligands. Coordination capacity (dentance) of ligands. Outer and inner spheres of complexes. Geometry of complex ion. The nature of the chemical bond in complex compounds. Classification of complex compounds by the charge of the outer sphere and by the nature of ligands. Intracomplex compounds. Polynuclear complexes. Ferrum-, cobalt-, copper- and zinc-containing biocomplex compounds. The concept of metalligand homeostasis. Violation of homeostasis. Complexones and their use in medicine as antidotes for heavy metal poisoning (chelation therapy) and as antioxidants in the storage of drugs.

Topic 3 Heat effects of chemical reactions in solutions. The direction of the processes

The subject of chemical thermodynamics. Basic concepts of chemical thermodynamics: thermodynamic system (isolated, closed, open; homogeneous, heterogeneous), state parameters (extensive, intensive), thermodynamic process (reversible, irreversible). Living organisms are open thermodynamic systems. Irreversibility of life processes. The first law of thermodynamics. Enthalpy. Thermochemical equations. Standard heat of formation and combustion. Hess's law. Calorimetry method. Energy characteristics of biochemical processes. Thermochemical calculations to assess the caloric content of food and the preparation of rational and therapeutic diets. Spontaneous and non-spontaneous processes. The second law of thermodynamics. Entropy. Thermodynamic potentials: Gibbs energy. Thermodynamic equilibrium conditions. Criteria for the direction of spontaneous processes. Application of the basic provisions of thermodynamics to living organisms. ATP as an energy source for biochemical reactions. Macroergic compounds. Energy conjugations in living systems: exergonic and endergonic processes in the body.

Topic 4 Kinetics of biochemical reactions. Chemical equilibrium

Chemical kinetics as a basis for studying the rates and mechanism of biochemical reactions. Reaction rate. Dependence of reaction rate on concentration. The law of active masses for the reaction rate. Reaction rate

Topic 5 Situational and computational problems. Final control of assimilation of the content module 1.

"Chemistry of biogenic elements. Complexation in biological fluids. Thermodynamic and kinetic laws of chemical processes.

Module 2. SOLUTIONS. ACID-BASIC EQUILIBRIUM IN BIOLOGICAL LIQUIDS

Topic 6 Values that characterize the quantitative composition of solutions. Preparation of solutions.

The role of solutions in the life of organisms. Classification of solutions. The mechanism of dissolution processes. Thermodynamic approach to the dissolution process. Solubility of substances. Solubility of gases in liquids. Dependence of gas solubility on pressure (Henry-Dalton's law), nature of gas and solvent, temperature. Influence of electrolytes on gas solubility (Sechenov's law). Solubility of gases in the blood. Bends. Solubility of liquids and solids in liquids. Dependence of solubility on temperature, nature of solute and solvent. Distribution of the substance between two immiscible liquids. Nernst distribution law and its significance in the phenomenon of permeability of biological membranes. Values that characterize the quantitative composition of solutions. Preparation of solutions with a given quantitative composition.

Topic 7 Colligative properties of solutions.

Colligative properties of dilute solutions of non-electrolytes. The relative lowering of the vapor pressure of the solvent over the solution. Raoult's law. Ideal solutions.Lowering of freezing point and increasing of boiling point of solutions in comparison with solvents. Osmosis and osmotic pressure. Vant-Goff's law. Colligative properties of dilute electrolyte solutions. Isotonic coefficient. Hypo-, hyper- and isotonic solutions. Cryometry, ebuliometry, osmometry, their application in medical and biological research. The role of osmosis in biological systems. Osmotic pressure of blood plasma. Haller's equation. Oncotic pressure. Plasmolysis and hemolysis.

Topic 8 Acid-base equilibrium in the body. Hydrogen ion exponent of biological liquids.

Electrolyte solutions. Electrolytes in the human body. Degree and constant of dissociation of weak electrolytes. Properties of solutions of strong electrolytes. Activity and activity rate. Ionic strength of the solution. Water-electrolyte balance is a necessary condition for homeostasis. Water dissociation. Ionic product of water. Hydrogen ion exponent pH. pH values for various liquids of the human body in normal and pathology. Theories of acids and bases. Types of protolytic reactions: neutralization, hydrolysis and ionization reactions. Hydrolysis of salts. Degree of hydrolysis, its dependence on concentration and temperature. Hydrolysis constant. The role of hydrolysis in biochemical processes. Fundamentals of titrimetric analysis. Methods of titrimetric analysis. Acid-base titration method. Acid-base indicators. Precipitation and dissolution reactions. The product of solubility. Conditions for precipitation and dissolution of sediments. The role of heterogeneous equilibrium with the participation of salts in the general homeostasis of the organism

Topic 9 Buffer systems, their biological role

Buffer solutions, their classification. Henderson-Hasselbach equation. The mechanism of buffer action. Buffer capacity. Blood buffer systems. Bicarbonate buffer, phosphate buffer. Protein buffer systems. The concept of acid-base state of the blood.

Topic 10 Situational and computational problems. Final control of assimilation of the content module2.

Solutions. Acid-base equilibrium in biological liquids.

Module 3. ELECTROCHEMICAL AND ELECTROKINETIC PHENOMENA IN BIOLOGICAL SYSTEMS. PHYSICO-CHEMISTRY OF SURFACE PHENOMENA.

Topic 11 Determination of redox potential

The role of electrochemical phenomena in biological processes. Electrode potentials and the mechanism of their occurrence. Nernst's equation. Normal (standard) electrode potential. Normal hydrogen electrode. Measurement of electrode potentials. Determination electrodes and comparison electrodes. Chlorine-silver electrode. Ion-selective electrodes. Glass electrode. Galvanic cells. Diffusion potential. Membrane potential. Biological role of diffusion and membrane potentials. Damage potential. The resting potential. Action potential. The role of redox reactions in life processes. Redox potential as a measure of oxidative and reducing capacity of systems. Peters equation. Normal redox potential. Prediction of the direction of redox reactions by the values

Topic 12 Sorption of biologically active substances. Ion exchange. Chromatography

Surface phenomena and their significance in biology and medicine. Surface tension of liquids and solutions. Surface tension isotherm. Surfactants and surfactants. Surface activity. Duclos-Traube rule. Adsorption at the liquid-gas and liquid-liquid interface. Gibbs equation. Orientation of surfactant molecules in the surface layer. Representation of the structure of biological membranes. Adsorption at the solid-gas interface. Langmuir's equation. Adsorption from the solution on the surface of the solid. Physical and chemical adsorption. Regularities of adsorption of solutes, vapors and gases. Freundlich equation. Physico-chemical bases of adsorption therapy (hemosorption, plasma sorption, lymphosorption, enterosorption, application therapy). Immunosorbents. Adsorption of electrolytes: specific (selective) and ion exchange. Panetta-Faience rule. Natural and synthetic ion exchangers. The role of adsorption and ion exchange in the vital processes of plants and organisms. Chromatography. Classification of chromatographic methods of analysis on the basis of the physical state of the phases, technique and distribution mechanism. Adsorption, ion exchange and distribution chromatography. Application of chromatography in biology and medicine.

Topic 13 Preparation, purification and properties of colloidal solutions

The organism as a complex set of dispersed systems. Classification of dispersed systems by degree of dispersion. Colloidal state. Lyophilic and lyophobic colloidal systems. The structure of colloidal particles. Double electric layer. Electrokinetic potential of a colloidal particle. Methods of obtaining and purifying colloidal solutions. Dialysis, electrodialysis, ultrafiltration, compensatory dialysis, vividialysis. Hemodialysis and the device "artificial kidney". Molecular kinetic properties of colloidal systems. Brownian motion, diffusion, osmotic pressure. Optical properties of colloidal systems. Electrokinetic phenomena. Electrophoresis. Helmholtz-Smoluchowski equation. Application of electrophoresis in research and clinical-laboratory practice. Electrophoregrams.

Topic 14 Coagulation of colloidal solutions. Properties of biopolymer solutions. Kinetic (sedimentation) and aggregative stability of dispersed systems. Stability factors. Coagulation. The mechanism of coagulating action of electrolytes. Coagulation threshold. Schultze-Hardy rule. Mutual coagulation. Coagulation processes in the treatment of drinking water and wastewater. Colloidal protection. Disperse systems with gaseous dispersion medium. Classification of aerosols, production methods and properties. Application of aerosols in clinical and sanitary practice. Toxic effects of some aerosols. Powders. Coarsely dispersed systems with liquid dispersion medium. Suspensions, production methods and properties. Pastes, their medical use. Emulsions, production methods and properties. Types of emulsions. Emulsifiers. The use of emulsions in clinical practice. Biological role of emulsification. Semi-colloidal soaps, detergents. Micelle formation in solutions of semi-colloids. Macromolecular compounds are the basis of living organisms. Globular and fibrillar structure of proteins. Comparative characteristics of solutions of macromolecular compounds, true and colloidal solutions. Swelling and dissolution of polymers. The mechanism of swelling. Influence of medium pH, temperature and electrolytes on swelling. The role of swelling in the physiology of the body. Jeweling of IUD solutions. The mechanism of dragging. The effect of pH, temperature and electrolytes on the rate of dredging.
Topic 15 Control of practical skills and abilities from the module "Fundamentals of Medical Chemistry" Tasks and calculation problems from the module "Fundamentals of Medical Chemistry".

5. Intended learning outcomes of the course

After successful study of the course, the student will be able to:

LO1	Explain the biological role of biogenic compounds, the structure of complex compounds
LO2	Interpret chemical reactions using knowledge of chemical thermodynamics, kinetics, equilibrium, theory of electrolytic dissociation, redox and electrochemical processes
LO3	Analyze the quantitative composition of solutions, the relationship between different types of concentrations, the relationship between concentration and colligative properties, prepare solutions with a given quantitative composition
LO4	To substantiate the mechanism of action of buffer systems and their role in maintaining acid-base balance in biosystems
LO5	Explain the laws of adsorption of substances, methods of chromatographic analysis, principles of methods for obtaining and purification of colloidal systems, properties of biopolymer solutions

6. Role of the course in the achievement of programme learning outcomes

Programme learning outcomes achieved by the course.
For 222 Medicine:

PO1	To detect and identify the leading clinical symptoms and syndromes (according to the List 1); to establish the most probable nosological or syndromic preliminary clinical diagnosis of diseases (according to the List 2) using standard methods, preliminary data of the patient's anamnesis, patient's examination data, and knowledge about a human, his organs and systems.

PO2	To collect information about the patient's general condition; to assess the patient's psychomotor and physical development and the state of organs and systems of the body; to assess information on the diagnosis (according to the List 4) based on laboratory and instrumental findings.
PO3	To order and analyze additional (mandatory and optional) examinations (laboratory, radiological, functional and/or instrumental) (according to the List 4) in order to perform a differential diagnosis of diseases (according to the List 2).
PO18	To search for the necessary information in the professional literature and databases; to analyze, evaluate, and apply this information. To apply modern digital technologies, specialized software, statistical methods of data analysis to solve complex health problems.

7. Teaching and learning activities

7.1 Types of training

Topic 1. Biogenic elements; biological role, application in medicine
pr.tr.1 "Introduction. s and p-Biogenic elements" (full-time course) General information about biogenic elements. Qualitative and quantitative content of biogenic elements in the human body. Macro elements, microelements and impurities. Organogens. The relationship between the content of biogenic elements in the human body and their content in the environment. Endemic diseases, their connection with the features of biogeochemical provinces (areas with natural deficiency or excess of certain chemical elements in the lithosphere). Problems of pollution and purification of the biosphere from toxic chemical compounds of man-made origin.
pr.tr.2 "d-biogenic elements." (full-time course) Electronic structure and electronegativity of s– and p– elements. Typical chemical properties of s– and p– elements and their compounds (reactions without changing the oxidation state). The relationship between the location of s– and p– elements in the periodic table and their content in the body. Application in medicine. Toxic effect of compounds. Qualitative reactions on CO32-, SO42-, NO2-, S2O32- ions
Topic 2. Complex formation in biological systems
lect.1 "Complex formation in biological systems.Basics of chelation therapy" (full-time course) Complexation reactions. A. Werner's coordination theory and modern ideas about the structure of complex compounds. The concept of complexing agent (central ion). Nature, coordination number, hybridization of complexing orbitals. The concept of ligands. Coordination capacity (dentance) of ligands. Outer and inner spheres of complexes. Geometry of complex ion. The nature of the chemical bond in complex compounds. Classification of complex compounds by the charge of the outer sphere and by the nature of ligands. Intracomplex compounds. Polynuclear complexes.

pr.tr.3 "Complexes" (full-time course)

Ferrum-, cobalt-, copper- and zinc-containing biocomplex compounds. The concept of metalligand homeostasis. Violation of homeostasis. Complexones and their use in medicine as antidotes for heavy metal poisoning (chelation therapy) and as antioxidants in the storage of drugs.

Topic 3. Heat effects of chemical reactions in solutions. The direction of the processes

pr.tr.4 "Heat effects of chemical reactions in solutions. The direction of the processes" (full-time course)

The first law of thermodynamics. Enthalpy. Thermochemical equations. Standard heat of formation and combustion. Hess's law. Calorimetry method. Energy characteristics of biochemical processes. Thermochemical calculations to assess the caloric content of food and the preparation of rational and therapeutic diets. Spontaneous and non-spontaneous processes. The second law of thermodynamics. Entropy. Thermodynamic potentials: Gibbs energy. Thermodynamic equilibrium conditions. Criteria for the direction of spontaneous processes. Application of the basic provisions of thermodynamics to living organisms. ATP as an energy source for biochemical reactions. Macroergic compounds. Energy conjugations in living systems: exergonic andThe first law of thermodynamics. Enthalpy. Thermochemical equations. Standard heat of formation and combustion. Hess's law. Calorimetry method. Energy characteristics of biochemical processes. Thermochemical calculations to assess the caloric content of food and the preparation of rational and therapeutic diets. Spontaneous and non-spontaneous processes. The second law of thermodynamics. Entropy. Thermodynamic potentials: Gibbs energy. Thermodynamic equilibrium conditions. Criteria for the direction of spontaneous processes. Application of the basic provisions of thermodynamics to living organisms. ATP as an energy source for biochemical reactions. Macroergic compounds.

Topic 4. Kinetics of biochemical reactions. Chemical equilibrium

pr.tr.5 "Kinetics of biochemical reactions. Chemical equilibrium" (full-time course)

Chemical kinetics as a basis for studying the rates and mechanism of biochemical reactions. Reaction rate. Dependence of reaction rate on concentration. The law of active masses for the reaction rate.

Topic 5. Situational and computational problems. Final control of assimilation of the content module 1.

pr.tr.6 "Final control of assimilation of the content module 1." (full-time course)

Execution of tasks of modular control.

Topic 6. Values that characterize the quantitative composition of solutions. Preparation of solutions.

pr.tr.7 "Preparation of solutions. Quantitative composition of solutions." (full-time course)

The role of solutions in the life of organisms. Classification of solutions. The mechanism of dissolution processes. Thermodynamic approach to the dissolution process. Solubility of substances. Solubility of gases in liquids. Dependence of gas solubility on pressure (Henry-Dalton's law), nature of gas and solvent, temperature. Influence of electrolytes on gas solubility (Sechenov's law). Solubility of gases in the blood. Bends. Solubility of liquids and solids in liquids. Dependence of solubility on temperature, nature of solute and solvent. Distribution of the substance between two immiscible liquids.

Topic 7. Colligative properties of solutions.

pr.tr.8 "Colligative properties of solutions of biological liquids" (full-time course)

Colligative properties of dilute solutions of non-electrolytes. The relative lowering of the vapor pressure of the solvent over the solution. Raoult's law. Ideal solutions.Lowering of freezing point and increasing of boiling point of solutions in comparison with solvents. Osmosis and osmotic pressure. Vant-Goff's law. Colligative properties of dilute electrolyte solutions. Isotonic coefficient. Hypo-, hyper- and isotonic solutions. Cryometry, ebuliometry, osmometry, their application in medical and biological research. The role of osmosis in biological systems. Osmotic pressure of blood plasma. Haller's equation. Oncotic pressure. Plasmolysis and hemolysis

Topic 8. Acid-base equilibrium in the body. Hydrogen ion exponent of biological liquids.

pr.tr.9 "Acid-base equilibrium in the body. Hydrogen ion exponent of biological liquids." (full-time course)

Electrolyte solutions. Electrolytes in the human body. Degree and constant of dissociation of weak electrolytes. Properties of solutions of strong electrolytes. Activity and activity rate. Ionic strength of the solution. Water-electrolyte balance is a necessary condition for homeostasis. Water dissociation. Ionic product of water. pH. pH values

Topic 9. Buffer systems, their biological role

lect.2 "Water-electrolyte balance as a necessary condition for homeostasis of the human body. Providing buffer systems with acid-base status of blood." (full-time course)

The role of solutions in the life of organisms. Classification of solutions. The mechanism of dissolution processes. Thermodynamic approach to the dissolution process. Solubility of substances. Solubility of liquids and solids in liquids. Dependence of solubility on temperature, nature of solute and solvent. Distribution of the substance between two immiscible liquids. Nernst distribution law and its significance in the phenomenon of permeability of biological membranes. Osmosis.

pr.tr.10 "Hydrolysis. Buffer systems, their biological role." (full-time course)

Hydrolysis constant. The role of hydrolysis in biochemical processes. Fundamentals of titrimetric analysis. Methods of titrimetric analysis. Acid-base titration method. Acid-base indicators. Precipitation and dissolution reactions. The product of solubility. Conditions for precipitation and dissolution of sediments. The role of heterogeneous equilibrium with the participation of salts in the general homeostasis of the organism.

Topic 10. Situational and computational problems. Final control of assimilation of the content module2.

pr.tr.11 "Final control of assimilation of the content module2." (full-time course)

Execution of tasks of modular control.

Topic 11. Determination of redox potential

lect.3 "Redox and bioelectric potentials. Their role in the vital functions of the organism." (full-time course)

The role of electrochemical phenomena in biological processes. Electrode potentials and the mechanism of their occurrence. Nernst's equation. Normal (standard) electrode potential. Normal hydrogen electrode. Measurement of electrode potentials. Determination electrodes and comparison electrodes. Chlorine-silver electrode. Ion-selective electrodes. Glass electrode. Galvanic cells. Diffusion potential. Membrane potential. Biological role of diffusion and membrane potentials. Damage potential. The resting potential. Action potential.

pr.tr.12 "Redox reactions." (full-time course)

The role of redox reactions in life processes. Redox potential as a measure of oxidative and reducing capacity of systems. Peters equation. Normal redox potential. Prediction of the direction of redox reactions by the values of redox potentials. The equivalent of oxidant and reducing agent. The value of redox potentials in the mechanism of biological oxidation processes. Potentiometry. Potentiometric determination of pH, ion activity. Potentiometric titration.

pr.tr.13 "Electrode potentials. Galvanic cell. Biological role of diffusion and membrane potentials." (full-time course)

Electrode potentials and the mechanism of their occurrence. Nernst's equation. Normal (standard) electrode potential. Normal hydrogen electrode. Measurement of electrode potentials. Determination electrodes and comparison electrodes. Chlorine-silver electrode. Ion-selective electrodes. Glass electrode. Galvanic cells. Diffusion potential. Membrane potential. Biological role of diffusion and membrane potentials. Damage potential. The resting potential . Action potential.

Topic 12. Sorption of biologically active substances. Ion exchange. Chromatography

pr.tr.14 "Surface phenomena in biological systems. Sorption of biologically active substances. Ion exchange. Chromatography" (full-time course)

Physico-chemical bases of adsorption therapy (hemosorption, plasma sorption, lymphosorption, enterosorption, application therapy). Immunosorbents. Adsorption of electrolytes: specific (selective) and ion exchange. Panetta-Faience rule. Natural and synthetic ion exchangers. The role of adsorption and ion exchange in the vital processes of plants and organisms. Chromatography. Classification of chromatographic methods of analysis on the basis of the physical state of the phases, technique and distribution mechanism. Adsorption, ion exchange and distribution chromatography. Application of chromatography in biology and medicine.

Topic 13. Preparation, purification and properties of colloidal solutions

pr.tr.15 "Colloidal solutions: preparation and properties.." (full-time course) The organism as a complex set of dispersed systems. Classification of dispersed systems by degree of dispersion. Colloidal state. Lyophilic and lyophobic colloidal systems. The structure of colloidal particles. Double electric layer. Electrokinetic potential of a colloidal particle. Methods of obtaining and purifying colloidal solutions. Dialysis, electrodialysis, ultrafiltration, compensatory dialysis, vividialysis. Hemodialysis and the device "artificial kidney".
Topic 14. Coagulation of colloidal solutions. Properties of biopolymer solutions.
lect.4 "Colloidal systems. Solutions of macromolecular compounds and their properties." (full-time course) Kinetic (sedimentation) and aggregative stability of dispersed systems. Stability factors. Coagulation. The mechanism of coagulating action of electrolytes. Coagulation threshold. Schultze-Hardy rule. Mutual coagulation. Coagulation processes in the treatment of drinking water and wastewater. Colloidal protection. Disperse systems with gaseous dispersion medium. Classification of aerosols, production methods and properties. Application of aerosols in clinical and sanitary practice. Toxic effects of some aerosols. Powders.
Topic 15. Control of practical skills and abilities from the module "Fundamentals of Medical Chemistry"
pr.tr.16 "Final module control of practical skills and abilities from the module "Fundamentals of medical chemistry".." (full-time course) Tasks and calculation tasks to check the level of formation of practical skills and abilities from the module "Fundamentals of Medical Chemistry".

7.2 Learning activities

LA1	Work during the lecture (listening, taking notes, participating in the discussion, etc.);
LA2	Execution of practical tasks
LA3	Discussion of theoretical issues
LA4	Performing chemical experiments
LA5	Solving computational problems.
LA6	Elaboration of educational information on the basis of available educational and methodical materials
LA7	Preparation for a practical class
LA8	Execution of control work
LA9	Interactive testing
LA10	E-learning and testing in systems (Google Classroom, MIX, Google meet, in the format of a YouTube channel)

8. Teaching methods

Course involves learning through:

TM1	Visualization lectures, interactive lectures, problem lectures, mini-lectures
TM2	Problem-searching method
TM3	Method of demonstrations
TM4	Practice-oriented learning

Lectures provide students educational information of the theoretical foundations of a holistic physicochemical approach for studing the processes of life and the ability to evaluate chemical properties and transformations of substances in the body, which is the basis for self-study of higher education (LO1, LO2, LO4, LO5). Lectures are complemented by practical classes that allow students to confirm the theoretical provisions of chemistry, which are used to explain the essence of the processes occurring in the body (LO1, LO2, LO3, LO4, LO5). Independent learning will be facilitated by preparation for lectures and practical classes, work in small groups during a chemical experiment, performance of test tasks, performance of individual tasks of control works, processing of educational information, etc.

During classes, students gain communication skills, the ability to work in a team, the ability to think logically and systematically, creativity; skills of written communication, reasoned expression of opinions. Preparation for practical classes will help students to develop and implement skills of logical and systematic thinking, skills in the synthesis and analysis of information, expression of ideas in written and oral form.

9. Methods and criteria for assessment

9.1. Assessment criteria

ECTS	Definition	National scale	Rating scale
	Outstanding performance without errors	5 (Excellent)	$170 \leq RD \leq 200$
	Above the average standard but with minor errors	4 (Good)	$140 \leq RD < 169$
	Fair but with significant shortcomings	3 (Satisfactory)	$120 \leq RD < 139$
	Fail – some more work required before the credit can be awarded	2 (Fail)	$0 \leq RD < 119$

9.2 Formative assessment

FA1	Examination of presentations and abstracts
FA2	Diagnostic testing
FA3	Teacher's instructions in the process of performing practical tasks
FA4	Questionnaire and oral comments of the teacher based on the results of the survey
FA5	Calculations
FA6	Examination and evaluation of written assignments

9.3 Summative assessment

SA1	Assessment of written or test works

SA2	Performing practical tasks, laboratory work, presentations
SA3	Final control: general module

Form of assessment:

1 semester		**200 scores**
SA1. Assessment of written or test works		**80**
	4x20	80
SA2. Performing practical tasks, laboratory work, presentations		**40**
	5x8	40
SA3. Final control: general module		**80**
		80

Form of assessment (special cases):

1 semester		**200 scores**
SA1. Assessment of written or test works		**80**
	4x20	80
SA2. Performing practical tasks, laboratory work, presentations		**40**
	8x5	40
SA3. Final control: general module		**80**
		80

The discipline provides the following methods of formative assessment: interviews and oral comments of the teacher on his results, the teacher's instructions during the process of laboratory work, self-assessment, discussion and mutual evaluation of students' tasks. Assessment during the semester is conducted in the form of oral and written surveys (TM1), interactive testing (TM2), tests (TM3). All work must be performed independently. The form of final control - the differentiated credit made in writing.

10. Learning resources

10.1 Material and technical support

MTS1	Videos of chemical experiments
MTS2	Library funds
MTS3	Software (to support distance learning, online surveys, virtual labs, etc.)
MTS4	Laboratory equipment, utensils and reagents
MTS5	Multimedia equipment
MTS6	Means of communication with Internet access

10.2 Information and methodical support

Essential Reading	
1	Medical chemistry: textbook / V.O. Kalibabchuk, V.I. Halynska, L.I. Hryshchenko et al. — 7th edition . - .K. ВСВ «Медицина», 2016 – 336 с.
Supplemental Reading	
2	Collection of individual exercises to the course «Medical chemistry» for students of specialty 1201 «Medicine» full-time education
Web-based and electronic resources	
3	https://mix.sumdu.edu.ua/study/course/4859
4	https://mix.sumdu.edu.ua/study/course/1111