MINISTRY OF HIGHER EDUCATION, SCIENCE AND INNOVATIONS OF THE REPUBLIC OF UZBEKISTAN

MINISTRY OF HEALTHCARE REPUBLIC OF UZBEKISTAN

TERMEZ BRANCH OF TASHKENT MEDICAL ACADEMY

DEPARTMENT OF MEDICAL AND BIOLOGICAL CHEMISTRY

«CONFIRM»

Deputy of director
for academic work
_____ Y.B.Gulyamov
«__27__» ___12_____ 2023

MODULE PROGRAM OF MEDICAL CHEMISTRY

Field of study:	900 000	– Health and welfare
Education:	910 000	– Healthcare
Area of education:	60910200	– General Medicine

Termez – 2023

The working curriculum of the module was prepared on the basis of the curriculum of the module developed and approved by the Tashkent Medical Academy, Order No. 246 "05" 08 2022 (Appendix 1) for the Tashkent Medical Academy.

Compiled by:

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Reviewers:	
Internal reviewer: **Z.A.Nurova**	- Termez branch of TMA, Dean of the Department of Medical Biology and histology.
External reviewer: **H.S.Tadjieva**	- TMA, Associate Professor of the Department of Medical and biological chemistry.

The working curriculum of the module was reviewed and approved at a meeting of the Department of Medical and biological chemistry.
(No.____ «___» _____ 2023)

The working curriculum of the module was approved by the Council of the Termez branch of Tashkent Medical Academy.
(No. 5 «27» 12 2023)

Head of the Department _____ **O.T.Pardayev**

Dean of pediatric faculty _____ **J.A.Mustanov**

Head of the educational and methodological department _____ **Z.U.Berdiyeva**

Module code	Academic year	Semester	Credits
MC11-207	2022-2023	1-2	7
Module type	**Language of study**	**Number of hours per week**	
Compulsory	English	4	

Module name	Credits	Classroom studies (hours)	Self-education (hours)	Overall load (hours)
Medical Chemistry	7	(24/71/10)105	(60/45)105	210
Total	7	(24/71/10)105	(60/45)105	210

I. CONTENT OF THE MODULE

Module learning objective – training specialists with knowledge of the basics of general, analytical, physical, colloidal chemistry, who are able to perform calculations of physicochemical quantities with knowledge of the essence of physicochemical processes, possessing knowledge of the basics of organic chemistry, who have mastered "Static biochemistry", which is an introductory part of biochemistry and includes study of the structure, properties and functions of biopolymers and bioregulators involved in biochemical processes,able to model and perform biochemical processes, able to understand the scientific foundations of chemical processes occurring in a living organism, at the cellular and molecular levels, able to apply the obtained theoretical knowledge in clinical practice.

Module tasks:

- formation of a methodological approach and scientific worldview;
- familiarizing students with the rules of work in a chemical laboratory;
- training in the definition, measurement, application of physical and chemical quantities;
- formation of knowledge on the structure, properties and functions of biologically active organic substances;
- developing students' skills in working with scientific chemical literature, teaching students the skills of solving problem and situational tasks;
- to bring to the consciousness of students the importance of the module "Medical Chemistry" for the development of other fundamental and clinical modules;
- formation of practical skills in performing chemical laboratory work necessary to understand the basic concepts, laws, rules of chemistry, chemical formulas and reactions, the structure and properties of inorganic and organic substances, physical and chemical quantities and the analysis of substances.

II. MAIN THEORETICAL PART

Themes and content of lectures, instructions and recommendations for their conduct:

Themes of lectures:

№	Themes of lectures	Hour
	1st semester	
1.	Introduction to Medical Chemistry. Chemistry and the environment. Biogenic elements.	2
2.	Solutions. Solubility of substances.	2
3.	Thermodynamics and Chemical Thermodynamics.	2
4.	Complex compounds.	2
5.	Electrical conductivity of electrolyte solutions.	2
6.	Physicochemical foundations of surface phenomena	2
7.	Physicochemical properties of dispersed systems.	2
1st semester total		**14**
2nd semester		
1.	Carbohydrates. Structure and function.	2
2.	Amino acids, peptides and proteins.	2
3.	The structure and function of nucleic acids.	2
4.	The structure and function of lipids.	2
5.	The structure, characteristics and mechanism of action of enzymes.	2
2nd semester total		**10**
1st year annual total:		**24**

The organization of lecture classes (form, type, equipment, etc.) is held for the flow of academic groups in auditoriums equipped with multimedia devices.

III. ***Themes and content of practical (laboratory) classes in the module, as well as general instructions and recommendations for their organization:***

The following topics are recommended for practical exercises:

№	Themes	Hours
	1st semester	
1.	Introduction to Medical Chemistry. Chemistry and environment. Chemistry of biogenic elements. Physical and chemical properties of s-, d-elements.	4
2.	Nuclear chemistry.	4
3.	Solutions. Colligative properties of solutions.	4
4.	Titrimetric analysis. Methods of neutralization. (Laboratory part)	4

	Titrimetric analysis. Oxidimetry methods.	
5.	Acid-base balance. Buffer systems. (Laboratory lesson).	4
6.	Chemical thermodynamics. Determination of the thermal effect of chemical reactions.	4
7.	Complex compounds. Biocomplex compounds. Intracomplex connections. Chelates. Complexometry.	4
8.	Fundamentals of electrochemistry. Electrical conductivity. Conductometry.	3
9.	Electrode processes. The emergence of potentials and their varieties. Potentiometry.	3
10.	Surface phenomena and adsorption. Chromatography. Qualitative adsorption reactions. Quantification of adsorption.	4
11.	Disperse systems. Classification, structure, preparation and methods of purification of colloidal systems.	4
12.	Molecular-kinetic and specific properties of colloidal systems. Stability of colloidal systems. Coarsely dispersed systems.	4
1st semester total		**46**
2nd semester		
13.	Fundamentals of organic chemistry. The main classes of organic compounds. OC reactivity. Acidity and basicity. Oxidation and reduction of organic compounds.	2
14.	Mono-polyfunctional compounds as metabolites and drugs. Aliphatic and aromatic alcohols.	3
15.	Heterofunctional compounds as metabolites and drugs. Amino alcohols as structural units of phospholipids in cell membranes. Heterofunctional benzene derivatives. Derivatives of salicylic, sulfanylic and aminobenzoic acids as pharmaceuticals.	3
16.	Heterocyclic compounds as metabolites and drugs. Neurotransmitters containing heteroatoms in the ring.	3
17.	Aminoacids. Classification, structure, properties and biological functions of amino acids.	3
18.	Peptides and proteins. Spatial conformations of proteins. Functions of peptides and proteins. Physicochemical properties of proteins. (Laboratory lesson).	3
19.	Nucleosides. Nucleotides. Mono - and polyphosphates of nucleosides. Nucleoside cyclophosphates. Nucleotide coenzymes. The structure of nucleic acids. Their functions. Primary and spatial structure of NA. Double helix of DNA. Complementary pairs. Tertiary structure of DNA. RNA types. The structure of the ribosome.	3
20.	Carbohydrates. Monosaccharides structure and properties. Di-, homo- and heteropolysaccharides, structure and properties. (Laboratory lesson).	3

21.	Lipids. Saponified simple lipids. Triacylglycerides Structure, properties and functions of saponifiable lipids.	3
22.	Lipids. Unsaponifiable lipids. Terpenes and steroids.	3
23.	The structure, classification and mechanism of action of enzymes. (Laboratory lesson). Enzymes. Regulation of enzyme activity. Enzyme inhibitors. Use of enzymes. Medical Enzymology.	3
24.	Vitamins. Fat-soluble vitamins. Structure and function. Water-soluble vitamins. Structure and function. Avitaminosis. Antivitamins. Vitamin-like substances.	3
2nd semester total		**35**
1st year annual total:		**81**

Practical classes are held separately for each academic group in classrooms equipped with multimedia devices. Active and interactive methods are used in the classroom. Technologies are used "Project training", "Case study" and others. Handouts and information are transmitted using multimedia devices. Laboratory classes are held separately for each study group in a laboratory equipped with chemical, physico-chemical devices, chemical preparations and chemical laboratory utensils.

IV. Practical skills:

1st semester

1. Preparation of solutions of a certain concentration. Preparation of physiological, hypotonic and hypertonic solutions of sodium chloride and glucose.
2. Titrimetric analysis. Determination of gastric acidity by neutralization method.
3. Buffer systems. Preparation of phosphate buffer solution with different pH values. Determination of the buffer capacity of the physiological buffer with pH 7,4.
4. Determination of calcium concentration in blood serum by complexometric method.
5. Determination of the thermal effect of chemical reactions.

2nd semester

6. Study of the physicochemical properties of proteins. Study of protein denaturation that occurs on the surface with changes in temperature, pH, chemicals, mechanical impact. Purification of proteins by dialysis.
7. Study of the effect of temperature, changes in pH, chemicals (activators and inhibitors) on the activity of enzymes using the example of the enzyme amylase.
8. Determination of the protein content in blood serum by the biuret reaction method.

Students must acquire competencies in the practice of preparing solutions, conducting reactions, measuring physical and chemical quantities, applying their knowledge in the study of other fundamental and clinical disciplines, as well as applying the knowledge gained in the professional activity of a doctor;

To develop a broad outlook, it is necessary to master the competencies of working with literature, analyzing the information read, using the information received to study medicine, understanding and further using information from literary sources in a foreign language, using measuring instruments, and analyzing the results.

IV. Self-study and independent work (IW)
Topics for self-study (105 hour)

№	Themes	Hours
	1st semester	
1.	Biological body fluids as solutions of electrolytes and non-electrolytes.	5
2.	Chemical bases of stone disease.	5
3.	The formation and consumption of energy in the process of metabolism.	5
4.	The role of nuclear chemistry in medicine.	5
5.	Endemic and occupational diseases associated with changes in the concentration of nutrients.	5
6.	Biologically active complex compounds.	5
7.	Electrochemical methods of treatment and diagnostics.	5
8.	The value of the adsorption process in the life of the body and methods of treatment.	5
9.	Possibilities of chromatography in medical research.	5
10.	Purification of colloidal systems by dialysis. The importance of chemistry in hemodialysis.	5
11.	Properties of coarsely dispersed systems and their application in medicine and pharmacology.	5
12.	Properties of solutions of high-molecular compounds. Rheological properties of blood.	5
	1st semester total	**60**
	2nd semester	
13.	**1.** Fundamentals of organic chemistry. The main classes of organic compounds. OC reactivity. Electron effekts, Aromaticity of organic compounds. Acidity and basicity. Oxidation and reduction of organic compounds.	3
14.	Modern medicines produced on the basis of hetero - and polyfunctional compounds.	4
15.	Modern medicines based on heterocyclic compounds.	4
16.	α - amino acids - as a component of coenzymes, hormones and vitamins.	4
17.	Protein peptides and hormones. Proteinopathies.	3

18.	The role of chemistry in forensic science.	4
19.	Artificial protein nutrient manufacturing and future opportunities.	4
20.	Application of DNA recombinants in medicine.	4
21.	Transfer of glucose across the membrane. Structure, specificity, clinical significance of glucose carriers.	3
22.	Stereochemistry of steroids and terpenes and important biological processes with their participation.	4
23.	The use of enzymes in medicine.	4
24.	Hereditary vitamin deficiencies. Metabolism and excretion of natural and artificial vitamins.	4
2nd semester total		**45**
1st year annual total:		**105**

Independent work on the medicinal chemistry module is carried out outside the classroom.

Students prepare essays, abstracts, presentations and graphic organizers on the proposed topics and present them to the teacher during extracurricular activities. In the presented work, it is necessary to give a comprehensive description of the chemical issues of the topic and to focus on the importance of this topic in medicine. The work performed must be relevant, contain new scientific data, enriched with animation and video films.

V.Learning outcomes / professional competencies

At the end of the 1st semester

1st semester

The student must have an idea:

• about the need for a medicinal chemistry module to master other fundamental and clinical modules;

• about basic concepts, laws, rules of chemistry, chemical formulas and reactions,

• about the structure and properties of inorganic and organic substances;

• about physical and chemical quantities, methods of analysis of substances;

have knowledge:

• about solutions of electrolytes and non-electrolytes, complex compounds, chemistry of biogenic elements, theory of solutions, buffer systems, their role in maintaining acid-base homeostasis, theoretical foundations of bioenergetics, factors affecting the course of biochemical processes; on the physicochemical foundations of conducting electric current by the human body, the formation of redox potentials and methods of diagnostics and treatment based on electrochemistry, on the physicochemistry of surface phenomena, physicochemical foundations of adsorption therapy, physicochemistry of dispersed systems and solutions of biopolymers and ***be able to use in further practice;***

• ***have the skills to conduct*** analysis; finding a scientific approach to research; have practical qualifications to perform chemical laboratory work required for the analysis of the chemical and physical properties of biologically significant inorganic compounds.

2nd semester

Student must:

• ***have an idea*** about concepts, laws, rules of organic chemistry, Butlerov's theory of the structure of organic substances, the spatial structure of organic substances, factors affecting their reactivity, methods of analysis of organic substances;

• ***have knowledge:*** about structure and properties of heterofunctional and heterocyclic compounds as drugs and participants in metabolism, on the structure and properties and functions of amino acids, biopolymer substances - proteins, carbohydrates, nucleic acids, lipids, the structure and function of enzymes and vitamins ***and be able to use in further practice;***

• ***have the skills to conduct:*** analysis; finding a scientific approach to research; have practical qualifications to perform chemical laboratory work required for the analysis of the chemical and physical properties of biologically significant organic compounds.

• During the module, students should learn how to simulate these reactions in the laboratory so that they can fully understand the biochemical processes that take place in the human body during metabolism. To do this, they must be able to use laboratory glassware, carry out reactions, measure physicochemical quantities, and also analyze these quantities, knowing the rules of work in a chemical laboratory.

VI. Educational technologies and methods

- Interactive games;
- Seminar (logical thinking, blitz poll);
- Group work;
- Producing a presentation;
- Individual projects;

Collaboration and protection projects.

VII. Requirements for completion credits:

Perform tasks and assignments presented in the form of current control, successfully pass oral and test tasks for intermediate and final types of control.

Criteria for controlling and assessing the knowledge of the acquisition of practical skills in students by the module

Score	Level	Equivalent score	Mark	Criteria
90-100	A	5	Excellent	The student makes an independent conclusion and decision, can think creatively, observe independently, put into practice the knowledge received, understand the essence of Science (Subject), know,Express, tell, have an idea of science (subject)
85-89	B+	4	Very good	The student makes an independent conclusion and decision, observes independently, is able to apply the knowledge received in practice, understands the essence of science (subject), knows, can express, tell, has an idea of science (subject)
71-84	B	4	Good	The student observes independently, is able to put into practice the knowledge received, understands the essence of science (subject), knows, can express, tell and has an idea of science (subject)
60-70	C	3	Satisfying	The student is able to put into practice the knowledge received, understand the essence of the subject (subject), know, Express, tell and have an idea of the subject (subject)
0-59	F	2	Unsatisfactory	The student has not mastered the science program, does not understand the essence of science (subject), does not have an idea of science (subject)

Main literature:

1. Masharipov S.M., Tadjiyeva X.S., Masharipova Sh.S. Medical chemistry. Textbook. Tashkent. 2018 y.

2. Alimxodjayeva N.T., Tadjiyeva X.S., Ikramova Z.A., Suleymanova G.G., Medical chemistry. Textbook. Tashkent. 2019 y.

3. Masharipov S.M. Tadjieva H.S. «Medical Chemistry. Practical and laboratory exercises». Textbook. 2021.

4. Masharipov S.M. Medical Chemistry. Textbook. Tashkent. 2022.

5. Masharipov S.M. Tadjieva H.S. «Medical Chemistry. Theoretical basis of practical and laboratory exercises». Textbook. 2022.

Additional literature:

1. Olimkhodjaeva N.T., Juraev A.J. and others. General Chemistry Guide. Textbook. Tashkent. 2005.

2. Kasimova S.S. Physical and colloidal chemistry. Tutorial. Tashkent. 2011.

3. Tukavkina N.A. Baukov U.I. Bioorganic chemistry. Textbook. – 2014. - M: «Medicine», 528 p.

4. Timberlake K.C. Chemistry: An Introduction to General, Organic and Biological Chemistry.Textbook. 2015.

5. Francis A. Organic Chemistry. Textbook. USA. 2013.

Web sites:

1. http://www.search.uz.com/

2. http://www.rudn.ru.com/

3. http://www.virtonomica.ru/partnership.com/

4. http://abc.chemistry.bsu.by/lit/Rahoisha_2011.pdf

5. http://www.happydoctor.ru/info/3

6. http://orgchem.ru/

7. http://www.chem.msu.su/rus/elibrary/

8. https://www.top-technologies.ru/

9. http://www.hemi.nsu.ru/

10. http://www.orgsyn.org/

http://window.edu.ru/library/resources

SYLLABUS FOR MEDICINAL CHEMISTRY

Full module name	**Medical chemistry**		
Module code: MTC MC	**Total: 7,0 credits** from this: **1st semester:** Current control - 4 credits Intermediate control - 0 credits (required for passing) **2nd semester:** Current control - 3 credit Final control (Test)-0 credits (mandatory to pass)	module period: 1-2 semester	ECTS: 0-100 ball
Direction of education	60910200 - General medicine	1st year bachelors	
Module duration	24 weeks		
Study hours	Total hours:	210	
	From this:		
	Lecture	24	
	Practical lessons	71	
	Laboratory lessons	10	
	Selfeducation hours	105	
Learning Module Status	Block up clinical modules		
University name, address	Termez branch of Tashkent medical academy. Termez city, I.Karimov st. 64		
Information about the teachers of this course	Lecturers: F.A.Umarov A.K.Nomozov practical trainers: F.A.Umarov A.K.Nomozov	E-mail: ufa090@inbox.ru abrornomozov055@gmail.ru	
Time and place of the session	1st building, 1st floor		
Module content	The Medical Chemistry module teaches students the chemical composition of a living organism based on modern scientific achievements, providing them with the general theoretical knowledge necessary to study the metabolism in the body. Explains the various physiological processes occurring in the body, provides information on the role of inorganic and organic substances in the occurrence of diseases in the activities of a general practitioner, as well as various drugs used in medicine. Medical chemistry,		

	teaching the structure, properties and functions of substances involved in metabolism, creates the basis for the study of the science of biochemistry, i.e., includes questions of "static biochemistry". Medical chemistry forms students' knowledge and skills in conducting physical, chemical and biological examination methods used in medical practice; gives an understanding of the causes of complications caused by a violation of the electrolyte balance of the human body, in particular, the chemistry of biogenic elements, their biological role. It is aimed at providing knowledge and skills about the micellar structure of biological fluids of the body, about the constancy of pH, about the acid-base properties of biological fluids of the body.
Prerequisites	Based on knowledge from chemistry, biology, mathematics, computer science
Postrequisites	Serves as the theoretical basis for the modules of biochemistry, biophysics, pharmacology, anatomy, pathological anatomy and pathological physiology, as well as for all preclinical and clinical modules.
The purpose of the module	The study of "static biochemistry", which is the introductory part of biochemistry, having knowledge of the basics of general, analytical, physical, colloidal chemistry, able to perform the calculation of physico-chemical quantities, knowing the essence of physico-chemical processes, having knowledge of the basics of organic chemistry, understanding the structure, properties and functions of biopolymers and biodegradable substances involved in biochemical processes, modeling and performing processes with their participation., training of specialists who are able to understand the scientific foundations of chemical processes occurring in a living organism at the cellular and molecular levels, apply the received theoretical knowledge in practice.
Module tasks	are familiarization of students with the rules of work in a chemical laboratory; training in the definition, measurement, application of physical and chemical quantities; teaching the structure, properties and functions of biologically active organic substances in the body; the formation of students' skills in working with scientific chemical literature, solving problematic and situational issues and performing experiments.

Requirements for knowledge, skills and abilities of students in the module	**At the end of the 1st semester, the student needs to know:** - rules for working in a chemical laboratory, names and purpose of the tools used; - preparation of solutions of a given concentration; - control-analytical determination of substances in biological fluids by titrimetric analysis; - study of the osmotic properties of blood plasma; - preparation of buffer solutions and checking their properties; - formation of complex compounds and determination of their properties; - determination of the total hardness of water; - qualitative reactions to cations of biogenic and inorganic elements; - determination of pH with a potentiometer; - study of adsorption phenomena in solid adsorbents; - preparation of colloids and verification of their properties; - study of the dependence of the rate of chemical reactions on various factors; - have the skills to apply methods of analysis of chemical phenomena and processes in order to find solutions to chemical problems. **At the end of the 2nd semester, the student needs to know:** - determining whether organic compounds are saturated or unsaturated; - difference in the oxidation of organic compounds in composition and structure; - acids and bases of alcohols, amines and carbonic acids; - determination of acetone in biological objects; - proof that the wine has two carboxyl groups in the acid; - proof of the presence of hydroxyl groups in tartaric acid; - difference in the quality of reactions of PAS and aspirin; - study of the properties of the return of uric acid; - qualitative reactions characteristic of amino acids; - reaction of xantoprotein and biuret to proteins; - qualitative reaction of the discovery of glucose in the urine-Hrommer's reaction; - the discovery of glucose with an alkaline solution of copper glycerate - the Gaines reaction; - specific reactions to triacylglycerols and terpenes. The student must have the skills to apply methods for

	analyzing chemical phenomena and processes, making decisions on chemical problems.
Education methods	lectures, practical classes, laboratory classes
Providing	Video lessons, presentations of practical exercises, chemical reagents, chemical glassware, pH meter, textbooks, handouts, tests, situational tasks, study guides.