Federal State Autonomous Educational Institution of Higher Education
People's Friendship University of Russia named after Patrice Lumumba
RUDN University

Medical Institute

educational division - faculty/institute/academy

COURSE SYLLABUS

Medical elementology

course title

Recommended by the Didactic Council for the Education Field of:

31.05.03 DENTISTRY

field of studies / speciality code and title

The course instruction is implemented within the professional education programme of higher education:

DENTISTRY

higher education programme profile/specialisation title

2023

1. Aims and objectives of the discipline:

• studying the biological role of macro- and microelements and their implications for human health;

• formation of clinical thinking in students for diagnosis, evaluation of disease prognosis and successful treatment;

• application of new methods and schemes of correction of various metabolic disorders and pathological processes.

2. The place of discipline in the structure of the high education main program:

The discipline «Medical elementology» refers to the medical-biological cycle.

Medical elementology is an interdisciplinary knowledge complex that lays the foundation for medical and biological training of a physician and contributes to the achievement of general professional (GP-8, GP-9) and professional (P-1P-11) competences.

3. Requirements for the results of the discipline:

Based on the results of the study of Medical elementology in conjunction with other disciplines, the student should have the following general cultural, general professional and professional competences:

- Ability to abstract thinking, analysis and synthesis, readiness for self-development, self-realization, self-education and use of creative potential. The student as a result of training should be able and ready to analyze the patterns of the influence of imbalance of vitally important and toxic elements on the metabolism and the formation of various pathologies for the timely diagnosis of diseases and pathological processes in the human body;
- Ability and willingness to analyze the results of their own activities to prevent professional errors; readiness to use basic physical, chemical, mathematical and other natural science concepts and methods in solving professional problems (GP-8); readiness for medical use of drugs and other substances and their combinations in solving professional problems (GP-9). Student as a result of training to be able to interpret the results of modern diagnostic technologies on the age-sex groups of patients taking into account the features of the human body and the environmental conditions of its existence for successful therapeutic and preventive activities;
- Ability and readiness to implement a set of measures aimed at maintaining and strengthening health, including the formation of a healthy lifestyle, preventing the occurrence and (or) spread of dental diseases, their early diagnosis, identifying the causes and conditions for their emergence and development, as well as on elimination of harmful influence on human health of factors of its habitat (P-1); readiness for collecting and analyzing patient complaints, data of his medical history, examination results, laboratory, instrumental and other studies for the purpose of recognizing the condition or establishing the presence or absence of a dental disease; readiness to determine the need for natural therapeutic factors, medicinal, non-medicinal therapy and other methods in patients with dental diseases who need medical rehabilitation and sanatorium treatment (P-11); readiness to teach patients and their relatives basic hygienic measures of a recreational nature, skills of self-monitoring of basic physiological indicators, contributing to the preservation and strengthening of health, the prevention of diseases; readiness for educational activities to eliminate risk factors and develop healthy life style skills.

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

To know:

- Safety rules and work in biochemical laboratories with reagents, instruments, animals;
- The role of biogenic elements and their compounds in living systems;
- Elements of biochemistry of tissues;

- Bases of bioelementology, principles of biogeochemical distribution of chemical elements;
- Approaches to correcting the imbalance of macro- and microelements;
- The role of macro and microelements in the specialty «Dentistry».

To be able to:

- use educational, scientific, popular scientific literature, the Internet and a training portal for professional activities;
- search for information on literary sources;
- classify chemical elements depending on their biological role;
- assume negative consequences for the organism of the imbalance of certain macro- and microelements.

To own:

- methods of applying the analyzes and solving specific practical and scientific problems;
- basic technologies for searching and transforming information, including using educational educational resources.

4. The amount of discipline and types of academic work

The total complexity of the discipline is 2 credit units.

Type of educational work	Total hours	Semesters			
		III			
Classroom activities (total)	**28**	**28**			
which includes:	-	-			
Lectures	-	-			
Practices (P)		-			
Seminars (S)		-			
Laboratory classes (LC)	28	28			
Individual work	**38**	**38**			
Kinds of interim attestation					
which includes*:*					
Current certification (colloquium)	4	4			
Differential pass-fail exams	2	2			
Total complexity hour credit unit	**72**	**72**			
	2	**2**			

5. Contents of the discipline

5.1. Contents of the discipline sections:

№	Name of the discipline section	Contents of the section

1	Introduction to Medical Elementology	1. Subject of medical elementology. Biological classification of chemical elements. The concept of bioelements.
		2. Biogeochemistry and factors affecting the elemental status of the population.
2	General Elementology	3. Factors affecting the homeostasis of microelements. Interaction between microelements
		4. Elemental status of a person. Personalized assessment of human elemental status.
3	Particular Elementology	5. Elements-organogenes (carbon, oxygen, nitrogen, hydrogen): a role in the body; suction; excretion; associated diseases; sources.
		6. Macroelements (potassium, sodium, calcium, magnesium, phosphorus, sulfur, chlorine): role in the body; suction; excretion; deficiency and excess; toxicity; associated diseases; sources.
		7. Essential trace elements (iron, zinc, copper, manganese, chromium, cobalt, molybdenum, selenium, iodine): role in the body; suction; excretion; deficiency and toxicity; associated diseases; sources.
		8. Conditionally essential microelements (lithium, strontium, vanadium, nickel, tin, silicon, fluorine): role in the body; suction; excretion; deficiency and toxicity; associated diseases; sources
		9. Toxic and potentially toxic microelements (arsenic, aluminum, lead, cadmium, mercury): role in the body; suction; excretion; toxicity; associated diseases; sources.
4	The role of chemical elements in dentistry	10. Imbalances of chemical elements for various diseases of the oral cavity: caries, pulpitis, periodontitis, gingivitis, periodontitis, periodontitis

5.2. Sections of discipline and interdisciplinary relations

No.	**Name of the ensured (subsequent) disciplines**	**No. of the sections of this discipline necessary for the study of the ensured (subsequent) disciplines**										
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1.	General dentistry	+		+	+	+	+	+	+	+	+	+
2.	Normal physiology	+	+	+	+	+	+	+	+	+	+	
3.	Pathophysiology				+	+	+	+	+	+	+	
4.	General Pharmacology				+	+	+	+	+	+	+	
5.	Clinical Pharmacology				+	+		+	+	+	+	
6.	Biochemistry	+	+	+		+			+	+	+	

5.3. Sections of the discipline and types of classes:

№	**Name of the discipline section**	**Lectures**	**Practical exercises and laboratory works**	**Individual student's work**	**Total hours**

			PE/S	*LW*	*of them in an interactive form*		
1.	Section 1	-	-	4	2	4	8
2.	Section 2	-	-	4	2	4	8
3.	Section 3	-	-	22	16	24	46
4.	Section 4	-	-	4	2	6	10
	Total:	**0**	**0**	**34**	**22**	**38**	**72**

6. Laboratory practical work.

On the laboratory class, the main theoretical questions are discussed in detail, repeated and generalized. Qualitative (logical) problems are being solved. Laboratory work is conducted with discussion of theoretical bases of medical elementology, data values for clinical diagnosis and selection of correction methods. In the classroom, students also answer the test questions of the current test work, distributed to them individually in printed form.

№	Section number of the discipline	Name of laboratory works	Complexity (hour.)
1.	1	Laboratory work №1. Preparation of the patient for the delivery of analyzes for the content of chemical elements. Significant factors for analysis.	2
2.	2	Laboratory work №2. Methods of sample preparation of hair, nails to mass spectrometric analysis.	2
3.	2	Laboratory work №3. Methods of sample preparation of blood (whole blood, serum, plasma) to mass spectrometric analysis.	2
4.	2	Laboratory work №4. Methods of sample preparation of urine and saliva for mass spectrometric analysis.	2
5.	1,2	Test №1 - Introduction to medical elementology. General elementology.	2
6.	3	Laboratory work №5. Determination of the content of chemical elements in solid biosubstrates (hair and nails). Interpretation of results.	2
7.	3	Laboratory work № 6. Determination of the content of chemical elements in serum and blood plasma. Interpretation of results.	2
8.	3	Laboratory work № 7. Determination of the content of chemical elements in whole blood. Interpretation of results.	2
9.	3	Laboratory work No. 8. Features of the determination of the content of macroelements in solid biosubstrates. Interpretation of results.	2
10.	3	Laboratory work No. 9. Features of the determination of the content of macroelements in liquid biosubstrates. Interpretation of results.	2
11.	3	Laboratory work №10. Methods of statistical processing of analysis results.	2
12.	4	Laboratory work №11. Identification of links between various diseases (not including dental diseases) and test results.	2
13.	2,3	Test №2 - Particular elementology.	2

14.	3,4	Laboratory work №12. Identification of links between diseases (caries, pulpitis, periodontitis) and test results.	2
15.	3,4	Laboratory work №13. Identification of links between diseases (gingivitis, periodontitis, periodontitis) and test results.	2
16.	1,2,3,4	A general class, the protection of abstracts (all sections).	2
17.	1,2,3,4	Examination class.	2

7. Practical exercises are not provided

8. Material and technical support of the discipline

1. Training classes equipped with multimedia projectors.

2. Computer classes, the information library center of the RUDN with access to the electronic library system of the RUDN, the Internet network.

9. Information support of the discipline

a) Software OS Windows XP, Vista, 7; set of office programs OpenOffice.org (or MS Office 2003, 2007); Internet search engines FireFox or Explorer, Opera or other; software tools for knowledge control. Databases - Medline, Pubmed, Excel, etc.

б) RUDN Library site - Access mode: http://lib.rudn.ru/ - from stationary computers of the PFUR

University library ONLINE - Access mode: http://www.biblioclub.ru

Book collections of the publishing house SPRINGER. - Access mode: www.springerlink.com

Bulletin of the Peoples' Friendship University (Series "Medicine") - Access mode: http: //www.elibrary.ru/defaultx.asp

Universal database East View. - Access mode: http://online.ebiblioteka.ru

Full-text collection of Russian scientific journals. eLibrary.ru - Access mode: http://elibrary.ru/defaultx.asp?

On-line access to journals. Information database on all branches of science and electronic delivery of documents. SwetsWise. - Access mode: https://www.swetswise.com

http://quakes.globalincidentmap.com

http://www.globalincidentmap.com

http://earthquake.usgs.gov/earthquakes/recenteqsww/Quakes/quakes_all.php

http://www.tesis.lebedev.ru/forecast_activity.html

Electronic Library System PFUR - EBS PFUR: http://lib.rudn.ru:8080/MegaPro/Web

The educational portal of PFUR (http://web-local.rudn.ru)

University library online: http://www.biblioclub.ru

National digital resource "RUKONT": http://rucont.ru

IQlib: http://www.iqlib.ru

Science Direct: http://www.sciencedirect.com

EBSCO: http://search.ebscohost.com

Sage Publications: http://online.sagepub.com

Springer / Kluwer: http://www.springerlink.com

Tailor & Francis: http://www.informaworld.com

Web of Science: http: //www.isiknowledge. com

University information system RUSSIA: http://www.cir.ru/index.jsp

The educational portal of the PFUR: http://web-local.rudn.ru

Consultant of the student http://www.studmedlib.ru

10. Methodological support

Basic literature

1) An Introduction to Medical Elementology: A Textbook. I.V. Radysh, A.V. Rocky. - Moscow: PFUR, 2015. - 200 p.: ill. ISBN 978-5-209-06691-0.

2) Oberlis D., Harland V., Skalny A. Biological role of macro and microelements in humans and animals. - SPb.: Science, 2008. - 544 p.

3) Skalny A.V., Lakarova E.V., Kuznetsov V.V., Skalnaya M.G. Analytical methods in bioelementology. - St. Petersburg: Science, 2009. – 264 p.

Additional literature

1) World Health Organization. (1996). Trace elements in human nutrition and health.

2) Skalny A.V. Bioelements and bioelementology in pharmacology and nutrition: fundamental and practical aspects // Pharmacology and nutritional intervention in the treatment of disease, Edited by Faik Atroshi. 2014.-P. 225-241.

3) Skalny A.V., Rudakov I.A. Notova S.V., Burtseva T.I., Skalny V.V., Baranova O.V., Gubaydulina S.G., Bioelementology: basic concepts and terms. IPK GOU OSU - Orenburg. - 2005. – 50 p.

4) Ibragimova M.Ya., Skalnaya M.G., Sabirova L.Ya., Skalny A.V., Zhdanov R.I. Exchange of macro and microelements in the human body. Modern methods of determining chemical elements in biological materials / Selected chapters of fundamental and translational medicine. R.I. Zhdanov, the manager. Ed. - Kazan: Kazan Publishing House. University. 2014. P. 330-346.

5) Skalny A.V. Microelements // Laboratory diagnostics of infectious diseases. Reference book / Ed. IN AND. Pokrovsky, M.G. Tvorogovoy, G.A. Shipulina. - Moscow: Publishing House BINOM, 2013 - 447- 467p.

6) Skalny A.V., Tsygan V.N. Pathophysiology of macro-and microelement exchange // Pathophysiology of Metabolism: a Textbook / Ed. V.N. Gypsy. - St. Petersburg: SpetsLit, 2013. - P. 262-333.

7) Skalny A.V. Chemical elements in human physiology and ecology. -M .: ONYX 21 Century: The World, 2004. -216 p.

8) Skalny A.V. Physiological aspects of the application of macro- and microelements. IPK GOU OSU - Orenburg, 2005. - 206 p.

9) Agadzhanyan N.A., Veldanova M.V., Skalny A.V. Ecological portrait of man and the role of microelements. -M., 2001. -236 p.

10) Skalny A.V., Rudakov I.A. Bioelements in medicine. -M.: ONYX 21 Century: The World, 2004. -272 p.

11. Guidelines for the students on the development of discipline (module)

The student is required to attend classes, perform the tasks of the instructor of the discipline, study with the recommended literature, etc. When attending the student it is assessed the quality of work in classes, the level of training for independent activity in the chosen field, the quality of the performance of teacher' discipline tasks, the ability to independently study the teaching material.

In practical exercises and lectures in the classrooms, the appropriate topics are analyzed using multimedia technology (computer, projector).

Independent work in class-off hours can take place both in the classroom and in the computer class, where students can study the material on presentations prepared by the Department's teachers, as well as on computer tests.

Presentations on the classes' topics can be recorded on a CD or flash card for independent work of students on a home computer.

Study guides in electronic form for a number of studying topics are posted on the Department' pages and on Department of Nursing Management and on the RUDN learning web portal, as well as on local resources of the electronic library system of the RUDN.

As one of the forms of independent work the preparation of abstracts for different sections of the course is provided.

Out-of-class independent work includes: the study of material on the textbook, manuals on paper and electronic media; preparation of abstracts on selected topics; preparation for the execution of control and test tasks.

12. Fund of assessment tools for students interim attestation in discipline (module)

(are developed and executed in accordance with the requirements of the "Regulations for the Formation of Funds for Evaluation Means (FAT), approved by the Rector's Order No. 420 of 05.05.2016).

The maximum mark for the discipline (its section), studied during one semester, is **100 points**, regardless of its volume.

Competence	Discipline section	FAT (control forms of the development level of the basic education program)						Section' s point	Pass exam
		Class work				Independent work			
		Опрос	Test	Practical exercise accomplishment	Colloquium	Homework accomplishment	Essay		
GC-8; GP-9, P-1 P-11;	Section 1: Introduction to medical elementology	0,5	2	0,5	10	0,5	5	**28**	**30**
	Section 2: General elementology	0,5	3	0,5		0,5	5		
	Section 3: Particular elementology	0,5	6	0,5	20	0,5	5	**32,5**	
	Section 4: The role of chemical elements in dentistry	0,5	3	0,5	-	0,5	5	**9,5**	
	Total								**100**

When assessing the level of discipline acquisition the **specific knowledge, abilities and skills** of the student for which the minimum level of their development should be indicated in the curriculum are subject to evaluation,

Table 1. Distribution of the load (hours and credits) in the semester and assessment stages of students

Distribution of teaching load in semester	32 hours of practical training	40 hours of independent work
Final assessment	Pass exam	

Total: 32 hours of classroom + 40 hours independent work of students.
Total: 72 hours, which corresponds to 2 credit units, which the student must earn per semester (100 points).

A student does not receive these credits if during the his studied course working with the teacher and independently, earns less than 51 points for each semester (out of 100 possible).

The total amount of points that the student receives at the end of the semester is composed of:

1) current academic performance per semester (subject tests, tests, interviews, work in class, essays, practical work accomplishment)
2) progress check (assessment received for the colloquium)
3) pass exam for a semester

Table 2. Evaluation of the results' capture of the discipline

Type of work	Number of work	Number of points	Total points sum
Laboratory research	**13**	**1**	**13**
Tests	**2**	**10/20**	**30**
Summative assessment	**1**	**30**	**30**
Attendance	**-**	**-**	**16**
Activity	**-**	**-**	**11**
TOTAL			**100**

Finish mark from table 3 is writing in academic record book.

Table 3. Correspondence of points and grades in the qualifying examination

Points	Traditional grade	Grade of ECTS
95-100	*Excellent* 5	A
86-94		B
69-85	*Good* 4	C
61-68	*Satisfactory* 3	D
51-60		E
31-50	*Unsatisfactory* 2	FX
0-30		F

(*in accordance with the current normative framework*)

Conformity of the evaluation systems (previously used assessments of the final academic performance, ECTS and grade-rating system ratings (GRS) of current academic performance marks).

The ECTS grades description

A («Excellent») - the theoretical content of the course has been mastered completely without defects, the necessary practical skills of working with the mastered material have been formed, all the training tasks provided for in the education program have been carried out, the quality of their performance is estimated by the number of points close to the maximum.

B («Very good») – the theoretical content of the course has been mastered completely without defects, the necessary practical skills of working with the mastered material mainly have been formed, all the training tasks provided for in the education program have been carried out, the quality of their performance is estimated by the number of points close to the maximum.

C («Good») – the theoretical content of the course has been mastered completely without defects, the some practical skills of working with the mastered material have been formed insufficiently, the performance quality of none of them is not estimated by the minimum number of 5 points, some types of tasks are executed with mistakes.

D («Satisfactory») - the theoretical content of the course is partially mastered, but the defects are not essential, the necessary practical skills of working with the mastered teaching material are mainly formed, most of the training tasks provided by the education program are carried out, some of the performed tasks may contain mistakes.

E («Moderate») - the theoretical content of the course is partially mastered, some practical work skills are not formed, many of the training tasks provided by the education program are not carried out or the quality of some of them is estimated by the number of points close to the minimum.

FX («Nominal unsatisfactory») – the theoretical content of the course is partially mastered, essential practical work skills are not formed, many of the training tasks provided by the education program are not carried out or the quality of some of them is estimated by the number of points close to the minimum, with additional individual work work on the course teaching material, it is possible to improve the quality of the performance of the study tasks.

F («Absolutely unsatisfactory») – the theoretical content of the course is not mastered, practical work skills are not formed, all of the training tasks are contained the gross mistakes, additional individual work work on the course teaching material will not lead to any significant improvement in the quality of the training tasks.

There are control tests on Department on for all topics.

Examples of assessment tools:

Abstracts' list on topics

1. Examples of clinical cases of dental diseases with pronounced disbalance of chemical elements (caries, pulpitis, gingivitis, periodontitis, periodontitis, periodontitis).
2. Examples of clinical cases of dental diseases with a pronounced disbalance of chemical elements (caries, pulpitis, gingivitis).
3. Metals in dentistry.
4. The using of arsenic in dentistry.
5. Effect of trace elements on dental diseases.
6. Mercurial stomatitis.
7. Zinc in the dentistry. The zinc influence on human health.
8. Silver in dentistry. The silver influence on human health.
9. Lead and tin in dentistry. The influence of lead and tin on human health.
10. Nickel in dentistry. The influence of nickel on human health.
11. Cobalt in dentistry. The cobalt influence on human health.
12. Toxicity of fluorine. Fluorosis.

13. Gold, palladium, mercury in dentistry. The effect of this elements on human health.
14. Factors of appearance the metal taste in the mouth.
15. Mechanisms of allergy development to dentures.
16. Diseases of the oral mucosa associated with a disbalance of elements in the organism.
17. Chemistry of tooth tissues.
18. Ecological diseases - Itay-Itay, Minamata, Keshan disease.
19. Organogenic elements (carbon, oxygen, nitrogen, hydrogen): a role in the body; associated diseases.
20. Relative essential elements (lithium, strontium, nickel): role in the organism, associated diseases.
21. Relative essential elements (tin, bromine, boron): role in the organism, associated diseases.
22. Toxic and potentially toxic elements (silver, gold, titanium): role in the organism, associated diseases.
23. Toxic and potentially toxic elements (aluminium, barium, thallium): role in the organism, associated diseases.
24. Elemental status of a human.
25. Medical using of trace elements
26. Elemental status of your city / region / country population.
27. Influence of the students elemental status on achievement.
28. Examples of the clinical cases of dental diseases with a pronounced disbalance of chemical elements.

List of test questions

Choose one or few right answers.

Most of the iron is present in the body in two chemical forms:

1. Fe^{0}
2. Fe^{4+}
3. Fe^{2+}
4. Fe^{3+}

Symptoms of acute iron poisoning are:

1. fatigue
2. gastralgia
3. vomiting
4. headache

Clinical signs of zinc deficiency in the human body are:

1. immunity disorder
2. pale skin and lips
3. connective tissue dysplasia (collagen synthesis disorder)
4. diabetes mellitus
5. muscular spasms
6. mental retardation

Elements that effect on the zinc absorption:

1. iron
2. sodium
3. copper
4. cadmium

In the structure of which antioxidant enzyme zinc atoms involved:

1. glutathione peroxidase
2. peroxidase

3. superoxide dismutase (SOD1)
4. catalase

Unrelated to anemia symptoms of copper deficiency, include:

1. vitiligo
2. white strips on the nails
3. connective tissue dysplasia
4. irritability

Unrelated to anemia symptoms of copper deficiency, include:

1. vitiligo
2. white strips on the nails
3. connective tissue dysplasia
4. irritability

Components of nutrition that affect the absorption of manganese:

1. phytic acid
2. ascorbic acid
3. carbohydrates
4. alcohol

Hallucinations are typical for:

1. manganese deficiency
2. neurological stage of intoxication with manganese
3. psychiatric stage of intoxication with manganese
4. subclinical excess of manganese

The main proteins-transporters of selenium in the blood stream are:

1. globulin
2. albumin
3. selenoprotein P
4. glutathione peroxidase

In what form is Se represented in the body:

1. selenocysteine
2. selenoprotein
3. selenomethion
4. trimethylsilenide

Iodine deficiency leads to:

1. cretinism
2. graves' disease (diffuse toxic goiter)
3. Myxedeme
4. endemic goiter

Iodine is excreted from the human body mainly with:

1. feces
2. sudor
3. hair
4. urine
5. exhaled air

Cobalt refers to:

1. Macroelements
2. Trace elements
3. Ultra-microcells
4. Toxic elements

Clinical manifestations of vitamin B12 deficiency:

1. aphthous stomatitis
2. vitiligo
3. increased level of bilirubin
4. muscular spasms
5. megaloblastic anemia
6. atypical dermatitis

Chronic poisoning of Cr (VI) leads to:

1. stroke
2. myocardial infarction
3. sclerosis of the lungs
4. lung cancer
5. mental retardation
6. urolithiasis

A chemical element that increases the excretion of molybdenum with urine:

1. selenium
2. sulfur
3. iron
4. nitrogen

The effect of vanadium on the total metabolism is related to its interaction with:

1. adrenaline
2. glucocorticoids
3. insulin
4. thyroid hormones

In what form is silicon in the body:

1. with hyaluronic acid
2. orthosilicic acid
3. shungite
4. silicon oxide
5. silane

List the calcium functions:

1. inhibits platelets aggregation
2. controls the balance of intracellular potassium
3. participates in the metabolism of proteins, fats and carbohydrates
4. provides the supporting function of bones
5. regulates heartbeat
6. participates in blood clotting

The causes of calcium deficiency in the body:

1. parathyroid disease
2. pancreas disease
3. kidney disease
4. deficiency of P, Pb, Zn, Co, Mg, Fe, K, Na
5. excess of vitamin D3
6. vitamin D3 deficiency

What elements are interacted with magnesium?

1. K
2. Na
3. Ca
4. P
5. Se
6. Zn

Magnesium deficiency contributes to the development of violations in the following organs:

1. myocardium
2. adrenal glands
3. pancreas
4. brain
5. mammary glands
6. biliary system

The main elements that affect the absorption of phosphorus are:

1. Mg
2. Co
3. Se

4. Cr
5. Zn
6. Ca

Biological fixing of potassium is:

1. 90-95%
2. 50-70%
3. 75-90%
4. 2-5%

Compare the elements (K, Na, S) and organs (systems) with a high content of these elements:

1. extracellular space
2. muscular system
3. musculoskeletal system
4. skin and its derivatives
5. liver
6. central nervous system

What sulfur compounds are extremely toxic to the body:

1. aluminokalievye alum
2. sulfur oxide
3. hydrogen sulfide
4. pyrite
5. carbon disulphide
6. Glauber's salt

The program was compiled in accordance with the requirements of the Federal state education standard of high education in the direction and profile of the training on 31.05.01 «**Medical care**» **(specialist's grade)**, approved by **order of the Ministry of Education and Science** of Russia from September 3, 2015, No. 964.

Developers:

Assistant Professor
of Department of Medical Elementology — A.A. Skalny

Head of the Department
of Medical Elementology — A.V. Skalny

Head of educational department

Head of the Department
of Nursing Management,
Deputy Director of the Medical Institute — I.V. Radysh