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**Federal state budgetary educational institution of higher education
Ural State Medical University
Ministry of Healthcare of the Russian Federation**

Department of general chemistry



УТВЕРЖДАЮ
Проректор по образовательной деятельности
А.А. Ушаков
«12» июня 2025 г.

COURSE OUTLINE

CHEMISTRY

Major: 31.05.03 Dentistry
Level of higher education: specialist
Qualification: General Dentist

Ekaterinburg
2025

The working program of the discipline "CHEMISTRY" is compiled in accordance with the requirements of the Federal State Educational Standard of Higher Education, specialty 31.05.03 Dentistry (specialist level), approved by order of the Ministry of Education and Science of the Russian Federation No. 984 dated 12.08.2020 (Edition with amendments No. 1456 dated 11/26/2020), and taking into account the requirements of the professional standard 02.005 "Dentist", approved by order of the Ministry of Labor and Social Protection of the Russian Federation of May 10, 2016 No. 227n (registered with the Ministry of Justice of the Russian Federation on June 2, 2016, reg. No. 42399)

Prepared by: Belokonova N.A., Doctor of Technical Sciences, Associate professor, Head of General chemistry department
Medvedeva O. M., PhD (Chemistry), assistant professor of General chemistry department
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Reviewed by: Andriyanova G.N, advanced doctor of Pharmaceutical Sciences, professor of Pharmacy Department

The course outline is approved by the department council 12.05.2025, the protocol No. 314

The course outline is approved by methodological commission in the specialty Dentistry, protocol No. 1 of 06/06/2025

1. The purpose and objectives of studying the discipline

The purpose of studying the discipline is to form ideas about the structure and transformations of organic and inorganic substances that underlie life processes and affect these processes, in direct connection with the biological functions of these compounds, for the development of competencies by graduates in accordance with the Federal State Educational Standard of Higher Education in the specialty of Dentistry, capable and ready to perform the work functions required by the professional standard of Dentist.

2. Objectives of the discipline:

1. Formation of knowledge and skills about the basic laws of thermodynamics and bioenergetics; about the structure and chemical properties of bioorganic compounds and their derivatives;
2. Formation of knowledge necessary when considering the physicochemical nature of the processes occurring in the human body at the molecular and cellular levels;
3. Formation of skills to perform, if necessary, calculations of the parameters of these processes, which will allow a deeper understanding of the functions of individual systems of the body and the body as a whole, as well as its interaction with the environment;
4. Training of a specialist who has a sufficient level of knowledge, skills, and is able to think independently and be interested in research work.

3. The place of discipline in the structure of the main educational program

2.1. The discipline "Chemistry" refers to the mandatory part of Block 1 "Disciplines (modules)" of the main educational program in the specialty 31.05.03 Dentistry (specialty level).

The discipline "Chemistry" is focused on the formation of knowledge, skills and abilities in the field of fundamental natural science training.

2.2. To study the discipline "Chemistry" it is necessary to master the school course of chemistry at an advanced level. The discipline "Chemistry" is necessary for the development of subsequent disciplines of the curriculum, such as "Clinical Aspects of Physical and Colloidal Chemistry", "Biochemistry".

4. Requirements for the results of mastering the discipline

This work program is focused on obtaining universal and general professional competencies, knowledge, skills and abilities according to the Federal State Educational Standard of VO of August 12, 2020 No. 984.

a) Universal competencies (UC): NO

b) General professional competencies (GPC);

Category (group) of general professional competencies	Code and name of general professional competencies	Labor function index and its content (from Professional Standart)	Code and name of the indicator of achievement of general professional competencies

Fundamentals of fundamental and natural scientific knowledge	GPC-8. Able to use the basic physico-chemical, mathematical and natural scientific concepts and methods in solving professional problems	Organizational managerial activity A/01.7	<p>IGPC-8.1 Knows: basic physical chemical, mathematical and natural scientific concepts and methods that are used in medicine</p> <p>IGPC-8.2 Able to: interpret the data of the main physical chemical, mathematical and natural scientific research methods in solving professional problems</p> <p>IGPC-8.3 Has practical experience: application of basic physical and chemical, mathematical and natural scientific research methods in solving professional problems</p>
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c) Professional (PC):NO

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

Know:

- structure and chemical properties of non-polymeric organic compounds;
- natural macromolecular compounds and their components;
- basic laws of thermodynamics and chemical kinetics. The doctrine of solutions. Properties of electrolyte solutions;
- redox balances and processes in the oral cavity;
- types of alloys used in dental practice.

Be able to:

- evaluate the physical and chemical properties of organic compounds according to their structure.
- evaluate the direction and speed of the reaction;
- prepare solutions and evaluate their physical and chemical properties;
- prepare solutions and evaluate their physico-chemical properties;
- evaluate the corrosion resistance of metals and alloys in the environment of the oral cavity;

- evaluate the direction of redox processes in the oral cavity;

Have practical skills on:

- skills of working on laboratory instruments: pH meter, photoelectric colorimeter;
- laboratory identification methods and methods for assessing the purity and good quality of medicinal products;
- methods for conducting qualitative reactions to detect components of biopolymers ;
- methods for assessing the purity and good quality of drugs.

The study of the discipline "Chemistry" is aimed at developing students' ability and readiness to perform the following labor functions / actions in their professional activities: Organizational and managerial activities

Job function A / 01.7

5. Scope of discipline and types of academic work

Types of study	Academic hours	Semester 1
Classroom occupations (all)	68	68
Including:		
Lectures	32	32
Practical training	18	18
Including:		
Laboratory works	18	18
Independent students work	40	40
Including:		
Coursework (course project)		
Abstract	10	10
Other types of independent work	30	30
Examination / Credit		Credit with evaluation
Total	108	

6. . Content of the discipline

6.1. Content of sections and didactic units of the discipline

Topic (didactic unit)	Description
Disciplinary module №1. General chemistry	
DU 1 Introduction to chemistry GPC-8	Introduction to the course. Methods for expressing the concentration of solutions Chemical kinetics. The concept of chemical equilibrium. The constant of chemical equilibrium and the ways of its expression. Law of the acting masses. Displacement of chemical equilibrium with changing temperature, pressure, concentration. Principle of Le Chatelier.

	<p>Theory of solutions of sparingly soluble electrolytes. Solubility constant. Factors affecting the formation and dissolution of precipitation in the body.</p> <p>Redox reactions. The mechanism of electrode and redox potentials. Comparative strengths of oxidizing and reducing agents. Predicting the direction of redox processes based on redox potential values.</p>
<p>DU 2 The doctrine of solutions GPC-8</p>	<p>The role of solutions in the vital functions of the body. Water as a solvent. The mechanism of the dissolution process. The importance of the phenomenon of dissolution in the processes of metabolism, in pharmacy, hygiene, sanitation. Effect on the solubility of the nature of the components and external conditions. Solutions of strong and weak electrolytes. Degree and constant of ionization of weak electrolytes. Basic points of strong electrolytes solutions theory. Electrolytes in the human body. Electrolyte composition of blood and tissues. The concept of water-salt metabolism. Antagonism and synergy of ions.</p> <p>Intervals of pH values for various fluids of the human body in norm and pathology. Colorimetric methods for pH measuring.</p> <p>Osmosis and osmotic pressure. Biological importance of osmosis. Buffer solutions, their classification. The mechanism of the buffer action. Buffer tank. Its determinants are factors. Biological buffer systems of the body.</p>
<p>Disciplinary module №2. Bioorganic chemistry</p>	
<p>DU 3 The main representatives of biologically significant non-polymeric organic compounds and their properties. GPC-8</p>	<p>Bioorganic chemistry, its subject, tasks.</p> <p>Mutual influence of atoms in a molecule. Electron-donor and electron-withdrawing substituents. Acidic properties of bioorganic compounds.</p> <p>The main representatives of biologically significant organic compounds and their qualitative reactions.</p> <p>Carboxylic acids. Composition and properties. Composition of "ketone bodies". Qualitative reactions of detection of "ketone bodies".</p>
<p>DU 4 Natural high-molecular compounds and their components GPC-8</p>	<p>Lipids. Classification of lipids. Principles of classification. Phospholipids. Steroids. Lipid composition of membranes. Biological functions of membranes.</p> <p>Natural amino acids. Nomenclature. Stereoisomerism. Features of the structure of amino acids that make up the proteins of the human body. Classification.</p> <p>Chemical properties of α-amino acids. Biologically important reactions of α-amino acids. Proteins and peptides are the most important natural biopolymers. Denaturation of protein, biological significance.</p> <p>Carbohydrates. Classification of carbohydrates. Monosaccharides. Classification. Stereoisomerism. The structure of the most important representatives. Chemical properties of monosaccharides in reactions in vitro, in vivo.</p> <p>Oligosugars. Classification. Polysaccharides. Classification. Homopolysaccharides: starch (amylose and amylopectin), glycogen,</p>

	<p>dextran, cellulose. Heteropolysaccharides: hyaluronic acid, chondroitin sulfates, heparin. Biological significance.</p> <p>Nucleic acids, nucleotides, nucleosides, nitrogen bases of nucleic acids. Nucleosides. Nomenclature. Hydrolysis of nucleosides. Nucleotides. Nomenclature. Hydrolysis of nucleotides. Nucleotides. Primary structure of nucleic acids. Chemical composition of RNA and DNA. Conditions for partial and complete hydrolysis. Secondary structure of DNA. The role of hydrogen bonds in the formation of a secondary structure. Complementary pairs</p>
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6.2. Monitored learning elements

Didactic unit (DU)	Supervised learning elements formed as a result of mastering the discipline			Stage of competence development
	Knowledge	Abilities	Skills	
<p>DU 1</p> <p>Introduction to chemistry</p> <p>GPC-8</p>	<p>Methods for calculating the concentration of solutions.</p> <p>Basic laws of chemical kinetics and equilibrium.</p> <p>Laws of oxidation-reduction processes.</p> <p>Laws of heterogeneous equilibria</p> <p>IGPC-8.1</p>	<p>Assess the possibility of shifting the direction of equilibrium when external conditions change.</p> <p>Assess the possibility of obtaining precipitates and the conditions for their dissolution.</p> <p>Determine the possibility and direction of redox processes.</p> <p>Prepare solutions, determine the concentration by electroconductivity</p> <p>IGPC-8.2</p>	<p>Skills in working on conductometer</p> <p>IGPC-8.3</p>	<p>elementary</p>

<p>DU 2</p> <p>The doctrine of solutions</p> <p>GPC-8</p>	<p>Properties of electrolyte solutions.</p> <p>Influence of solutions' composition on its osmotic, and buffer properties</p> <p>IGPC-8.1</p>	<p>Determine physico-chemical properties of solutions</p> <p>Prepare buffer solutions and evaluate the buffering capacity of the solution.</p> <p>IGPC-8.2</p>	<p>IGPC-8.3</p> <p>Skills in working on pH meter</p> <p>IGPC-8.3</p>	<p>elementary</p>
<p>DU 3</p> <p>The main representatives of biologically significant non-polymeric organic compounds and their properties.</p> <p>GPC-8</p>	<p>Fundamentals of the theory of hybridization, conjugation, electronic effects, acid-base properties of bioorganic substances. Classification, nomenclature, structure, chemical and physical properties, biological significance of metabolites: carboxylic acids, high fatty acids, lipids.</p> <p>IGPC-8.1</p>	<p>Determine the type of hybridization of carbon atoms, the type of conjugation in the molecules of organic substances. Compare acid-base properties, name them according to modern and historical nomenclature, determine their place in the classification of substances.</p> <p>IGPC-8.2</p>	<p>Laboratory methods for the identification of organic substances</p> <p>IGPC-8.3</p>	<p>elementary</p>

<p>DU 4</p> <p>Natural high-molecular compounds and their components</p> <p>GPC-8</p>	<p>Classification, nomenclature, structure, chemical and physical properties, biological significance of metabolites: amino acids, proteins, monosaccharides, polysaccharides, nucleosides, nucleotides, nucleic acids.</p> <p>IGPC-8.1</p>	<p>Determine classification features, name according to modern and historical nomenclature.</p> <p>Evaluate the physicochemical properties of polymeric organic compounds according to their structure. Explain the biological effect of substances depending on their structure and properties.</p> <p>IGPC-8.1 IGPC-8.2</p>	<p>Methods for conducting qualitative reactions for the detection of components of biopolymers.</p> <p>IGPC-8.3</p>	<p>elementary</p>
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6.3. Sections of the discipline (DU) and types of classes

No. disciplinary module	№ of the didactic unit	Hours by type of occupation				Overall:
		Lectures	Practical classes	Laboratory works	self-study	
№ 1. General chemistry.	DU 1 The doctrine of solutions	8	6		10	24
	DU 2 Buffer systems. Theory of heterogeneous equilibria. Fundamentals of chemical thermodynamics and bioenergetics. Chemical kinetics. Chemical equilibrium.	8	4	6	10	28

№ 2. Bioorganic chemistry	DU 3 The main representatives of biologically significant non-polymeric organic compounds and their properties.	8	4	6	10	28
	DU 4 Natural high-molecular compounds and their components	8	4	6	10	28

7. Additional topics to study

In the course students have an opportunity to study additional topics in the subject under supervision of a teacher.

7.1 Coursework: not provided by the curriculum

7.2 Educational research, creative work (laboratory work):

- Influence of various factors on chemical equilibrium.
- Determination of pH of biological fluids and electrolyte solutions.
- Determination of the buffer capacity of buffer solutions for acid and base.
- Electrochemical research methods. Conductometric method for determining the electrical conductivity of biological fluids.
- Qualitative reactions involving carboxylic acids.
- Qualitative reactions to proteins. Determination of the isoelectric point of a protein.
- Qualitative reactions to monosaccharides.
- Qualitative reactions to polysaccharides.

7.3 Essays:

- Derivatives of aromatic carbonic acids as medicines.
- Lipotropy medications. Use of dietary supplement on the basis of polyunsaturated fatty acids.
- Application of derivatives of cellulose in medicine.
- A B6 vitamin role in reactions of reamination and decarboxylation of amino acids.
- Optical isomerism and pharmacological activity
- Peptide and proteinaceous hormones.
- Eicosanoids: a structure, properties and application in medicine.
- Methods of quantitative definition of proteins in biological liquids.
- Mono - and polysaccharides - medicines.
- The modified nucleosides - medicines.

- Methods of quantitative definition of uric acid and its salts of urat.
- Detection of nucleic acids in a hydrolyzate of yeast.
- Calculations of caloric content of food.
- Energy drinks.
- Receiving buffer systems.
- Determination of buffer capacity of various means.
- Research of buffer systems by various methods (potentiometry).
- Definition of a constant of dissociation of acetic acid by conductometry.
- Medicines – electrolytes
- Water and electronic balance. Osmometry, its application in a research of biological liquids

8. Learning resources

The department has human resources that guarantee the quality of specialist training in accordance with the requirements of the Federal State Educational Standard of Higher Education in the specialty 31.05.03 – Dentistry, approved by order of the Ministry of Education and Science of the Russian Federation. Provided that the student studies diligently, he/she will acquire the knowledge, skills and abilities necessary for the qualification level required of a graduate in the specialty.

The educational process is implemented by the scientific and pedagogical staff of the department, who have higher education and work experience in the specialty "Chemistry", as well as those who have the academic degree of candidate of chemical sciences, the academic degree of doctor of sciences, and the academic title of associate professor.

8.1 Educational technologies

In educational process lectures, a practical training, creative tasks and the test controlling tasks for a practical training, performance by students of educational and research and research works are used.

Electronic information and education environment: educational, educational and methodical information is provided on MedSpace (edu.usma.ru), all students have access to electronic educational resources (the electronic catalog and electronic library of the university, EBS "Student's Consultant").

8.2. Material equipment

The demonstration equipment (the laptop, multimedia projector), lecture audience, educational rooms with visual aids, a computer class.

Types of the main study	Devices	Student's work	Control
Lecture course	Laptop, multimedia projector	Contents making an abstract	Poll on a classes, test control, micro-control

Practical classes	Laboratory equipment, chemical ware, reactants	Solution of tasks and exercises, performance of laboratory works	Oral poll, performance of laboratory works, test control, mikrokontrol, offset
The name of the chemical equipment used in educational process		The name of the additional equipment used in educational process	
- Devices: pH-meters, analytical scales, conductometers, spectrophotometers. - Chemical ware and equipment. - Chemical reactants.		1. The laptop – 4; 2. A multimedia projector – 2; 3. The personal computer – 16 (including 10 - in a computer class) 4. The printer – 4; 6. The copier – 2	

8.3. List of licensed software:

8.3.1. System software

8.3.1.1. Server software:

- VMwarevCenterServer 5 Standard, license term: permanently; VMwarevSphere 5 EnterprisePlus, license term: permanently, contract № 31502097527 dated 30.03.2015 LLC «Krona-KS»;
- WindowsServer 2003 Standard № 41964863 dated 26.03.2007, № 43143029 dated 05.12.2007, license validity period: permanently;
- WindowsServer 2019 Standard (32 cores), License agreement № V9657951 dated 25.08.2020, license validity period: 31.08.2023, Microsoft Corporation;
- ExchangeServer 2007 Standard (license № 42348959 dated 26.06.2007, whether-censorship: permanently);
- SQL ServerStandard 2005 (license № 42348959 dated 26.06.2007, license validity period: permanently);
- CiscoCallManager v10.5 (contract № 31401301256 dated 22.07.2014, validity period of the license: permanently), LLC «Microtest».
- Ideco UTM Enterprise Edition security gateway (license № 109907 dated 11/24/2020, license term: permanently), LLC «AYDEKO».
- Kaspersky Endpoint Security for Business antivirus software (1100 users) (agreement No. 32514755780 dated May 6, 2025, license valid until June 13, 2027, Exact LLC).

8.3.1.2. Operating systems of personal computers:

– Windows 7 Pro (OpenLicense № 45853269 of 02.09.2009, № 46759882 of 09.04.2010, № 46962403 of 28.05.2010, № 47369625 of 03.09.2010, № 47849166 of 21.12.2010, № 47849165 of 21.12.2010, № 48457468 of 04.05.2011, № 49117440 of 25 03.10.2011, № 49155878 of 12.10.2011, № 49472004 of 20.12.2011), validity period licenses: permanently);

– Windows7 Starter (OpenLicense № 46759882 dated 09.04.2010, № 49155878 dated 12.10.2011, № 49472004 dated 20.12.2011, license validity period: permanently);

– Windows 8 (OpenLicense № 61834837 dated 09.04.2010, license validity period: permanently);

– Windows 8 Pro (OpenLicense № 61834837 dated 24.04.2013, № 61293953 dated 17.12.2012, license validity period: permanently);

8.3.2. Application software

8.3.2.1. Office programs

– OfficeStandard 2007 (OpenLicense № 43219400 dated 12/18/2007, № 46299303 dated 12/21/2009, license term: permanently);

– OfficeProfessionalPlus 2007 (OpenLicense № 42348959 dated 06/26/2007, № 46299303 dated 12/21/2009, license term: permanently);

– OfficeStandard 2013 (OpenLicense № 61293953 dated 17.12.2012, № 49472004 dated 20.12.2011, № 61822987 dated 22.04.2013, № 64496996 dated 12.12.2014, № 64914420 dated 16.03.2015, license term: permanently);

8.3.2.2. Data processing programs, information systems

– Software "TANDEM.University" (including educational portal educa.usma.ru) (license certificate № UGMU/20 dated 17.09.2020, license validity period: permanently), Tandem IS LLC.

– iSpring Suite Concurrent software, concurrent license for 4 users (agreement No. 916-1 dated July 30, 2025, Richmedia LLC). The license is valid until July 30, 2026;

– Software for organizing and conducting webinars Videoconferencing server PART_CUSTOM_PC-3300 (Registry entry No. 14460 dated 08/08/2022), for 10,000 users (Agreement No. 32515088751 dated 08/18/2025, Infosafe LLC). The license is valid until 08/29/2026;

– Access to the Kinescope media archive storage and distribution system for 100 users (Agreement No. 32514918890 dated June 26, 2025, PTBO LLC). The license is valid until August 29, 2026.

8.3.2.3. External electronic information and educational resources

– Student Consultant LLC, Contract № 200/14 dated 08/20/2021 is valid until 08/31/2022.

– LLC "Electronic Publishing house YURAYT" License Agreement № 201/14 dated 08/20/2021 is valid until 08/31/2022.

– LLC "IVIS" License Agreement № 157-P dated 09.06.2021 (periodic editions) is valid until 31.12.2021.

– Letter from the Russian Foundation for Basic Research dated June 30, 2022, No. 909, "On granting licensed access to the content of Springer Nature's databases."

– Letter from the Russian Research Center dated November 21, 2022, No. 1541, On granting licensed access to the electronic version of the journal "Uspekhi Khimii" in 2022 under a centralized subscription.

9. Course books and materials

9.1. Electronic educational editions

Chemistry [An electronic resource]: tutorial for practical and laboratory works in Chemistry for the first year students of the faculties of General Medicine and Pediatrics in English/ Belokonova N. A., Naronova N. A.; FSBEI HE USMU of the Ministry of Health of Russia. — Yekaterinburg : IIC Quality Mark, 2020. — 198 p. - <http://elib.usma.ru/handle/usma/2255>

Fundamentals of bioorganic chemistry [An electronic resource]: textbook / Zurabyan S.E. - M.: GEOTAR-media, 2015. - <http://www.studmedlib.ru/book/ISBN9785970434437.html>

9.2. Textbooks

N.A. Tyukavkina, Yu.I. Baukov, S.E. Zurabyan. Bioorganic chemistry: the textbook for higher education institutions. M.: GEOTAR-media. 2014 - 410 pages.

10. Certification in the discipline

Certification of students is carried out in accordance with the developed point-rating system for evaluating students' academic achievements in the discipline.

Final assessment for the course is conducted in the form of a written test with a grade. Students who have fully mastered the course curriculum are admitted to the test (provided they have earned at least 40 rating points and successfully passed the final assessments for each module).

11. Evaluation materials

Evaluation materials are presented in App 1.

Рецензия

на рабочую программу дисциплины базовой части «Химия»
для обучающихся по специальности 31.05.03 «Стоматология»

Рабочая программа дисциплины составлена в соответствии с требованиями Федерального государственного образовательного стандарта высшего образования по специальности 31.05.03 Стоматология (уровень специалитета), утвержденного приказом Министерства образования и науки Российской Федерации от 12.08.2020 № 984 и с учетом требований профессионального стандарта «Врач-стоматолог», утвержденный приказом Министерства труда и социальной защиты Российской Федерации от 10.05.2016 № 224 н. (зарегистрирован в Министерстве юстиции РФ 02.06.2016 г. рег. № 42399).

Дисциплина «Химия» преподается на первом курсе в первом семестре в рамках дисциплин обязательной части, ориентирована на формирование знаний, умений и навыков в области фундаментальной естественнонаучной подготовки. Общая трудоемкость дисциплины 108 часов, в том числе 68 часа аудиторной работы и 40 часов самостоятельной работы.

Разработчики:

Белоконова Н.А., д.т.н., зав. кафедрой общей химии;
Наронова Н.А., к.п.н., доцент кафедры общей химии;
Лопатин Д.А., к.х.н., старший преподаватель
кафедры общей химии.

Представленная на рецензию рабочая программа дисциплины «Химия» при обучении по специальности «Стоматология» посвящена современным подходам в создании, обеспечении поддержании качества в подготовке специалиста «врач-стоматолог». Развитие современной качественной медицинской помощи невозможно без гарантированной подготовки будущих врачей. Рабочая программа полностью соответствует цели дисциплины – овладение студентами необходимым объемом теоретических и практических знаний по химии, для освоения выпускниками компетенциями в соответствии с ФГОС ВО специальности «Стоматология». Структура дисциплины соответствует поставленным задачам: формирование умений оценивать физико-химические свойства различных соединений (органических и неорганических) и навыков работы на приборах; формирование представлений о строении и превращениях органических и неорганических веществ, лежащих в основе процессов жизнедеятельности и влияющих на эти процессы, в непосредственной связи с биологическими функциями этих соединений.

В целом Рабочая программа дисциплины «Химия» отвечает требованиями, предъявляемым по специальности «Стоматология», в соответствии с ФГОС 3++, и может быть рекомендована для утверждения.

Рецензент: доктор фармацевтических наук, профессор,
профессор кафедры фармации
ФГБОУ ВО УГМУ Минздрава России



Г.Н. Андрианова