



MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION  
Federal State Budgetary Educational Institution of Higher Education  
«KAZAN STATE POWER ENGINEERING UNIVERSITY»  
(FSBEI HE «KSPEU»)

APPROVED

Director of the Institute of Digital  
Technologies and Economics

\_\_\_\_\_ Zainullin R.R.

«24» \_\_\_\_\_ February \_\_\_\_\_ 2026

## WORK PROGRAM FOR THE DISCIPLINE

### B1.M.13 Concepts of modern natural science

Field of training

38.03.02 Management

Qualification

Bachelor's Degree

Kazan, 2026

The program was developed by:

|                                   |                                 |             |
|-----------------------------------|---------------------------------|-------------|
| Department                        | Academic degree                 | Full name   |
| Materials science and engineering | Candidate of technical sciences | A.E. Buntin |

| Agreement | Department  | Date       | № Protocol  | Signature   |
|-----------|---|------------|-------------|---|
| Approved  | Materials science and engineering   | 20.02.2026 | No. 8       | _____<br>Head of department, doctor of chemical sciences, associate professor R.S. Davletbaev |
| Agreed    | Management  | 10.02.2026 | Protocol №5 | _____<br>Head of department, doctor of sociological sciences, professor                       |
| Agreed    | Educational and methodological council of institute of digital technologies and economics | 24.02.2026 | Protocol №6 | _____<br>Director, candidate of technical sciences, associate professor                       |
| Approved  | Academic council of institute of digital technologies and economics                       | 24.02.2026 | Protocol №6 | _____<br>director, candidate of technical sciences, associate professor                       |

## 1. Purpose, Objectives and Planned Learning Outcomes of the Discipline

The purpose of mastering the discipline “Concepts of Modern Natural Science” is to introduce students to the foundations of natural science in order to develop a holistic worldview based on the unity of material nature, its constituent objects, and the paradigm of the multi-level organization of the Universe as a whole.

Objectives of the discipline:

- to introduce students to the foundations of natural science;
- to form an integrated scientific worldview of the universe;
- to teach students to apply the fundamental laws of natural science in professional activity.

Competencies and indicators formed in students:

| Competence code and name   | Indicator code and name  |
|--|--|
| GPC-2<br>Is able to collect, process, and analyze data necessary for solving management tasks using modern tools and intelligent information and analytical systems. | GPC-2.3<br>Possesses mathematical and natural science culture as part of professional and universal human culture.   |
|  | GPC-2.4<br>Knowledge of the laws of development of nature, society, and thinking, and the ability to apply this knowledge in professional activities Ability to analyze and evaluate socially significant phenomena, events, and processes; mastery of the basic methods of quantitative analysis and modeling, theoretical and experimental research. |

## 2. Position of the discipline in the structure of the educational program

Preceding disciplines (modules), internships, research work, etc.: none

Subsequent disciplines (modules), internships, research work, etc.: Final state certification

## 3. Structure and content of the discipline

### 3.1. Structure of the discipline

**For full-time study**

| Type of academic work            | Total credits | Total hours | Semester |
|----------------------------------|---------------|-------------|----------|
|                                  |               |             | 1        |
| TOTAL WORKLOAD OF THE DISCIPLINE | 4             | 144         | 144      |
| CONTACT WORK *                   | -             | 65          | 65       |
| CLASSROOM WORK                   | 1,39          | 50          | 50       |
| Lectures                         | 0,94          | 34          | 34       |
| Practical (seminar) classes      | 0,45          | 16          | 16       |
| Laboratory work                  | -             | -           | -        |
| INDEPENDENT STUDY                | 2,61          | 94          | 94       |
| Study of educational materials   | 1,61          | 58          | 58       |
| Course project                   | -             | -           | -        |

|                                    |   |    |      |
|------------------------------------|---|----|------|
| Course paper                       | - | -  | -    |
| Preparation for interim assessment | 1 | 36 | 36   |
| Interim assessment:                |   |    | Exam |
|                                    |   |    | -    |

For part-time (blended) study

| Type of educational work           | Total credits | Total hours | Semester |
|------------------------------------|---------------|-------------|----------|
|                                    |               |             | 3        |
| TOTAL WORKLOAD OF THE DISCIPLINE   | 4             | 144         | 144      |
| CONTACT HOURS *                    | -             | 44          | 44       |
| CLASSROOM HOURS                    | 0,66          | 24          | 24       |
| Lectures                           | 0,33          | 12          | 12       |
| Practical (Seminar) classes        | 0,33          | 12          | 12       |
| Laboratory work                    | -             | -           | -        |
| INDEPENDENT STUDY                  | 3,34          | 120         | 120      |
| Study of course materials          | 3,09          | 111         | 111      |
| Course project                     | -             | -           | -        |
| Course paper                       | -             | -           | -        |
| Preparation for interim assessment | 0,25          | 9           | 9        |
| Interim assessment:                |               |             | Exam.    |
|                                    |               |             | -        |

### 3.2. Course content structured by modules and types of instruction

| Course modules | Total hours | Workload distribution by type of academic activity |                 |                   |                   | Forms and type of assessment | Competency indicator codes |
|----------------|-------------|--|-----------------|-------------------|-------------------|------------------------------|----------------------------|
|                |             | Lectures   | Laboratory work | Practical classes | Independent study |                              |                            |
| Module 1       | 46          | 10   |                 | 4                 | 32                | CC1                          | GPC-2.3, GPC-2.4           |
| Module 2       | 50          | 12   |                 | 6                 | 32                | CC2                          | GPC-2.3, GPC-2.4           |
| Module 3       | 48          | 12   |                 | 6                 | 30                | CC3                          | GPC-2.3, GPC-2.4           |
| Examination    |             |  |                 |                   | 36                | <b>AM 1</b>                  | GPC-2.3, GPC-2.4           |
| <b>TOTAL</b>   | <b>144</b>  | <b>34</b>  |                 | <b>16</b>         | <b>94</b>         |                              |                            |

### 3.3. Content of the discipline

**Section 1.** Scientific knowledge. Characteristics of the fundamentals of natural science

Topic 1.1. Structure of scientific knowledge. Methodology of scientific research. Criteria for the truth of scientific knowledge.

Topic 1.2. Scientific picture of the world

The concept of the scientific picture of the world (SPW). Mechanical picture of the world (MPW). Thermodynamic picture of the world (TPW). Electromagnetic picture of the world (EMPW). Quantum-field picture of the world (QFPW).

Topic 1.3. Natural science as a science of phenomena and laws of nature.

Structure of natural science. Main stages in the development of natural science. Scientific revolutions and their role in natural science.

Topic 1.4. Specific features of natural science and humanities types of culture. Unity and differences between natural sciences and humanities.

**Section 2.** Evolution of the development of the Universe.

Topic 2.1. Basic cosmological concepts.

Basic cosmological concepts. The Big bang theory. Origin and evolution of the Universe.

Topic 2.2. Structure of the Universe.

Structural self-organization of the Universe. Birth and evolution of galaxies. Origin and evolution of stars. The solar system.

Topic 2.3. Origin of life on earth as a phenomenon.

Concepts of the origin of life on Earth (educational video «Genesis»). Life as a form of existence of matter.

Topic 2.4. Characteristics of the structure of the Earth.

History of the formation of the Earth's geospheres. Modern structure of the Earth's geospheres.

Topic 2.5. Biosphere and general characteristics of its components.

Basic biosphere units. Ecological factors. Biotic interactions. Trophic chains and trophic levels.

Topic 2.6. Global environmental problems (problem lecture).

Global environmental problems of the modern world. Sources and consequences of environmental pollution. Ways of solving global environmental problems. Forecasts for the future of humanity.

Section 3. Human as a subject of natural-scientific cognition.

Topic 3.1. Problems of Human origin.

Theory of evolution. Theories of human origin. Anthropogenesis. Evolutionary tree of humans.

Topic 3.2. Human as a biological being.

Human physiology. Main systems of the human organism.

Topic 3.3. Human as a Social Being.

Human. An individual. Personality. Social qualities of personality.

Topic 3.4. The Human mind (educational video «The Human Mind»).

General information about the brain. Higher mental functions. Mind and cognition. Their place and role in human life.

### **3.4. Thematic plan of practical classes.**

1. Scientific cognition.

2. Natural science as a science about the phenomena and laws of nature.

3. Structure of the Universe.

4. Origin of life on Earth as a phenomenon.

5. Biosphere and general characteristics of the objects composing it.

6. Global environmental problems.

7. The problem of the origin of humans.

## 8. Human as a biological and social being.

### 3.5. Thematic plan of laboratory work.

*“This type of work is not provided for by the curriculum”.*

### 3.6. Course project / course paper.

*“This type of work is not provided for by the curriculum”.*

## 4. Assessment of Learning Outcomes.

Assessment of learning outcomes in the discipline is carried out within the framework of current control and intermediate assessment conducted under the point-rating system (PRS).

Scale for assessing learning outcomes in the discipline.

| Competence code   | Competency indicator code  | Planned learning outcomes  | Level of indicator achievement   |   |  |  |
|---|--|--|--|---|--|--|
|   |  |  | High   | Medium  | Below average  | Low  |
|   |  |  | от 85 до 100   | от 70 до 84   | от 55 до 69  | от 0 до 54   |
|   |  |  | Assessment Scale   |   |  |  |
|   |  |  | Excellent  | Good  | Satisfactory   | Unsatisfactory   |
|   |  |  | Pass   |   |  | Fail   |
| GPC-2 - Is able to collect, process, and analyze data necessary for solving management tasks using modern tools and intelligent information and analytical systems. | GPC -2.3 - Possesses mathematical and natural science culture as part of professional and universal human culture. | Knowledge:   |  |   |  |  |
|   |  | Core concepts and laws of philosophy, historical stages in the development of knowledge, evolutionary stages in the development of views on the structure of the Universe and society. | Fully demonstrates knowledge of the core concepts and laws of philosophy, historical stages in the development of knowledge, and evolutionary stages in the development of views on the structure of the Universe and society. | Knows the core concepts and laws of philosophy, historical stages in the development of knowledge, and evolutionary stages in the development of views on the structure of the Universe and society with errors and shortcomings. | Does not fully know the core concepts and laws of philosophy, historical stages in the development of knowledge, and evolutionary stages in the development of views on the structure of the Universe and society. | Does not know the core concepts and laws of philosophy, historical stages in the development of knowledge, and evolutionary stages in the development of views on the structure of the Universe and society. |
|   |  | Be able to:  |  |   |  |  |
|   |  | Distinguish the object and subject of different sciences and classify them based   | Demonstrates all the main abilities to distinguish the object and subject of different   | Demonstrates all the main abilities to distinguish the object and subject of different  | Does not fully demonstrate the abilities to distinguish the object and subject of different  | Does not demonstrate the abilities to distinguish the object and subject of different  |

|  |  |   |   |  |   |   |
|--|--|---|---|--|---|---|
|  |  | on differences in the material object or the set of objects studied by them.  | sciences and classify them based on differences in the material object or the set of objects studied by them.   | sciences and classify them based on differences in the material object or the set of objects studied by them with minor errors.  | sciences and classify them based on differences in the material object or the set of objects studied by them.   | sciences and classify them based on differences in the material object or the set of objects studied by them.   |
|  |  | Skills:   |   |  |   |   |
|  |  | Universal methodology of cognition of the object and subject of research in various sciences, foundations of intercultural communication.                         | Demonstrates confident and accurate application of the universal methodology for cognition of the object and subject of research in various sciences and effectively applies the principles of intercultural communication. | Demonstrates the ability to apply the universal methodology for cognition of the object and subject of research in various sciences and the principles of intercultural communication with minor inaccuracies. | Demonstrates limited ability to apply the universal methodology for cognition of the object and subject of research in various sciences and the foundations of intercultural communication. | Does not demonstrate the ability to apply the universal methodology for cognition of the object and subject of research in various sciences or the principles of intercultural communication. |
|  | GPC-2.4 - Knowledge of the laws of development of nature, society, and thinking, and the ability to apply this knowledge in professional activities Ability to analyze and evaluate socially significant phenomena | Knowledge:  |   |  |   |   |
|  |  | Fundamental laws of individual natural science disciplines and the law of conservation of mass and energy and the ability to apply them in professional activity. | Fully knows the fundamental laws of individual natural science disciplines and the law of conservation of mass and energy and applies them in professional activity.  | Knows the fundamental laws of individual natural science disciplines and the law of conservation of mass and energy and applies them in professional activity with errors and shortcomings.                    | Partially knows the fundamental laws of individual natural science disciplines and the law of conservation of mass and energy and applies them in professional activity.                    | Does not know the fundamental laws of individual natural science disciplines and the law of conservation of mass and energy and does not apply them in professional activity.                 |
|  |  | Skills:   |   |  |   |   |
|  |  | Construct a scientific material model of the  | Correctly constructs a scientific material model of the Universe  | Constructs a scientific material model of the Universe and   | Constructs a scientific material model of the Universe with   | Does not demonstrate the ability to construct a scientific  |

|  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|
|  | a, events, and processes; mastery of the basic methods of quantitative analysis and modeling, theoretical and experimental research. | Universe and demonstrate the contribution of various sciences to the unified scientific «tree of knowledge»; apply scientific methods in research of objects of professional activity. | and demonstrates the contribution of various sciences to the unified scientific «tree of knowledge»; applies scientific methods in research of objects of professional activity.       | demonstrates the contribution of various sciences to the unified scientific «tree of knowledge» with minor errors; applies scientific methods in research of objects of professional activity. | significant errors and demonstrates limited understanding of the contribution of sciences to the unified scientific «tree of knowledge»; applies scientific methods partially. | material model of the Universe or to demonstrate the contribution of sciences to the unified scientific «tree of knowledge»; does not apply scientific methods in research of professional activity objects. |
|  |  | Skills:  |  |  |  |  |
|  |  | Culture of thinking, ability to generalize, analyze, perceive information, set goals and choose ways to achieve them based on the available information.                               | Fully demonstrates skills of thinking culture, the ability to generalize, analyze, perceive information, set goals and choose ways to achieve them based on the available information. | Demonstrates skills of thinking culture, the ability to generalize, analyze, perceive information, set goals and choose ways to achieve them with minor shortcomings.                          | Partially demonstrates skills of thinking culture, the ability to generalize, analyze, perceive information, set goals and choose ways to achieve them.                        | Does not demonstrate skills of thinking culture, the ability to generalize, analyze, perceive information, set goals and choose ways to achieve them.  |

Assessment materials for ongoing assessment and interim certification are provided in the Appendix to the course syllabus.

The complete set of tasks and materials required to assess learning outcomes in the discipline is stored at the department responsible for the course development.

## **5. Educational and methodological and information support of the discipline.**

### **5.1. Educational and methodological support.**

#### 5.1.1. Core literature:

1. Concepts of modern natural science: textbook for universities / G. I. Ruzavin. – 2nd edition, revised and expanded. – Moscow: UNITY-DANA, 2008. – 304 p. – ISBN 978-5-238-01364-0. – Text: direct.

2. Concepts of modern natural science: study guide / G. V. Andreichenko,

Yu. G. Volkov, S. N. Epifantsev [and others]; edited by S. I. Samygin. – Moscow: KnoRus, 2023. – 464 p. – ISBN 978-5-406-06132-9. – URL: <https://book.ru/book/925887>. – Text: electronic.

3. Concepts of modern natural science. Lecture notes: study guide / A. A. Gorelov. – Moscow: KnoRus, 2022. – 204 p. – ISBN 978-5-406-02600-7-K-2018. – URL: <https://book.ru/book/929500>. – Text: electronic.

#### 5.1.2. Additional Literature:

1. Concepts of modern natural science. Workshop: study guide / M. A. Babaeva. – 2nd ed., expanded. – Saint Petersburg: Lan, 2022. – 296 p. – ISBN 978-5-8114-2458-0. – Text: electronic // Lan: electronic library system. – URL: <https://e.lanbook.com/book/209792>. – Access mode: for authorized users.

2. Antiquity: the emergence of scientific knowledge: study guide for universities / D. M. Kolomyts. – Kazan: KGEU, 2009. – 108 p. – URL: <https://lib.kgeu.ru>. – 3582. – Text: direct.

3. Concepts of modern natural science: textbook for universities / S. Kh. Karpenkov. – Moscow: UNITY, 2004. – 640 p. – ISBN 5-8291-0379-6. – Text: direct.

## 5.2. Information support.

### 5.2.1. Electronic and internet resources.

1. Concepts of modern natural science (lms2.kgeu.ru).  
<https://lms2.kgeu.ru/course/view.php?id=1209>

2. Big bang Theory. Origin and evolution of the Universe.  
<https://yandex.ru/video/preview/6424476022182178458>

### 5.2.2. Professional databases / Information reference systems.

- |                      |  |
|----------------------|--|
| 1. Nano              | <a href="http://nano.nature.com">nano.nature.com</a>                   |
| 2. Platform          | <a href="http://www.link.springer.co">www.link.springer.co</a>         |
| 3. SpringerMaterials | <a href="http://www.materials.springer.com">www.materials.springer</a> |
| 4. CyberLeninka      | <a href="https://cyberleninka.ru/">https://cyberleninka.ru/</a>        |

### 5.2.3. Licensed and freely distributed software of the discipline.

| №<br>п/п | Name of the software | Distribution type<br>(licensed/free)                                   | Details of supporting documents  |
|----------|----------------------|--|--|
| 1        | Windows 10           | User operating system.   | LLC “Softline Trade” № Tr096148 dated 29.09.2020. Non-exclusive rights until 14.09.2021. |
| 2        | LMS Moodle           | Software for effective online interaction between teacher and students | Free license. Non-exclusive rights. Unlimited term.                                      |
| 3        | Adobe Acrobat        | Software package for creating and viewing PDF files.                   | Free license. Non-exclusive rights. Unlimited term.                                      |

|   |        |  |   |
|---|--------|--|---|
| 4 | Chrome | Information search system on the Internet. | Free license. Non-exclusive rights. Unlimited term. |
|---|--------|--|---|

## 6. Material and technical resources for the course.

| Type of academic work | Classroom / specialized laboratory  | Required equipment and technical teaching aids   |
|-----------------------|---|--|
| Lectures              | Lecture classroom.  | Specialized educational furniture, technical teaching aids for presenting educational information to a large audience (multimedia projector, computer (laptop), screen), demonstration equipment, teaching aids. |
| Practical classes     | Classroom for seminars, group and individual consultations, ongoing and interim assessment. | Specialized educational furniture, technical teaching aids (multimedia projector, computer monoblock (15 units), classroom board, etc.).   |
| Independent work      | Computer class with Internet access B-600a.   | Specialized educational furniture for 30 seats, 30 computers, technical teaching aids (multimedia projector, computer (laptop), screen), software.   |
|                       | Library reading room.   | Specialized educational furniture, computer equipment with Internet access and access to the Electronic Information Educational Environment (EIOS), screen, multimedia projector, software.                      |

## 7. Features of the organization of educational activities for persons with disabilities and persons with limited health capabilities.

Persons with limited health capabilities (LHC) and persons with disabilities have the opportunity to move freely from one educational and laboratory building to another, access all floors of educational and laboratory buildings, and study in classrooms and other facilities taking into account the characteristics of psychophysical development and health conditions.

For students with LHC and disabilities who have disorders of the musculoskeletal system, conditions are provided for barrier-free access to all educational premises. Information about special conditions created for students with LHC and disabilities is available on the university website [www.kgeu.ru](http://www.kgeu.ru). It is also possible to receive technical assistance from assistants as well as sign language interpreters and deaf-blind interpreters.

For adaptation to the perception of educational material by persons with LHC and disabilities with hearing impairments, the following conditions are provided:

- for better orientation in the classroom, signals are used to notify about the beginning and end of classes (the word “bell” is written on the board);
- attention of hearing-impaired students is attracted by the teacher using gestures (a hand is placed on the shoulder, a light tapping is performed);

- while speaking with students, the teacher faces them, speaks clearly and in short sentences, ensuring the possibility of lip reading.

Compensation for difficulties in speech and intellectual development of hearing-impaired students is carried out through:

- the use of diagrams, charts, drawings, computer presentations with hypertext and comments on individual elements of images;

- regular use of exercises aimed at graphical highlighting of essential features of objects and phenomena;

- providing the student with the opportunity to receive targeted consultation via e-mail if necessary.

For adaptation to the perception of reference, educational and educational-methodological materials by persons with LHC and disabilities with visual impairments in accordance with the educational program in the chosen field of training, the following conditions are provided:

- adaptation of the official website on the Internet taking into account the special needs of visually impaired persons, ensuring the availability of enlarged reference information and class schedules;

- the teacher, his/her interlocutor (if necessary), when present in the classroom, introduces themselves to the student, while each time clearly states the name of the person being addressed;

- movements of the teacher in the classroom are briefly and clearly commented;

- printed information is provided in large font (from 18 points) and is fully voiced;

- the necessary level of illumination of the premises is ensured;

- students are given the opportunity to use computers during classes and to record explanations using a dictaphone (at the student's request).

The form of ongoing and interim assessment for students with LHC and disabilities is determined by the teacher in accordance with the curriculum. If necessary, students with LHC or disabilities, taking into account their individual psychophysical characteristics, are given the opportunity to take interim assessment orally, in writing on paper, in writing on a computer, in the form of testing, etc., or additional time is provided for preparing the answer.

## **8. Methodological recommendations for teachers on organizing educational work with students.**

Methodological support of the educational process of student upbringing is one of the determining factors of the high quality of education. A university teacher, demonstrating high professionalism, erudition, an active civic position, self-discipline, and a creative approach to solving professional tasks during the educational process, contributes to the formation of a harmonious personality.

When implementing the discipline, the teacher may use the following methods of educational work:

- methods of forming personal awareness (conversation, discussion, suggestion, instruction, control, explanation, example, self-control, narration, advice, persuasion, etc.);

- methods of organizing activities and forming behavioral experience (task, public opinion, pedagogical requirement, assignment, training, creation of educational situations, training exercises, etc.);

- methods of motivating activity and behavior (approval, encouragement of social activity, reprimand, creation of situations of success, creation of situations for emotional and moral experiences, competition, etc.).

When implementing the discipline, the teacher should take into account the following areas of educational activity.

*Civic and patriotic education:*

- formation of students' holistic worldview, Russian identity, respect for their family, society, and the state, for the spiritual and moral and sociocultural values accepted in the family and society, national, cultural and historical heritage, and the formation of the desire to preserve and develop them;

- formation of students' active civic position based on traditional cultural, spiritual and moral values of Russian society, for increasing personal responsibility for the realization of their constitutional rights and duties;

- development of legal and political culture of students, expansion of constructive participation in decision-making affecting their rights and interests, including in various forms of self-organization, self-governance, and socially significant activities;

- formation of motives and moral attitudes of the individual that allow resistance to extremism, xenophobia, discrimination on social, religious, racial, national grounds, interethnic and interconfessional intolerance, and other negative social phenomena.

*Spiritual and moral education:*

- development of a sense of dignity, honor and honesty, conscientiousness, respect for parents, teachers, people of the older generation;

- formation of the principles of collectivism and solidarity, a spirit of mercy and compassion, and the habit of caring for people in difficult life situations;

- formation of solidarity and a sense of social responsibility towards people with disabilities, overcoming psychological barriers in relation to people with disabilities;

- formation of an emotionally rich and spiritually elevated attitude towards the world, the ability and willingness to convey one's aesthetic experience to others.

*Cultural and educational development:*

- formation of an aesthetic worldview;

- fostering respect for the cultural values of one's hometown, region, and country;

- improvement of students' cognitive activity.

*Scientific and educational education:*

- formation of a scientific worldview among students;

- formation of the ability to gain knowledge;

– formation of information analysis and synthesis skills, including in the professional field.

**Changes introduced and approved for the new academic year.**

| № | Section number where the change is introduced | Date of the change | The content of the changes | «Agreed» by the Head of the department implementing the discipline. | «Agreed» Chairman of the UMK of the Institute (faculty), which includes the graduate department. |
|---|---|--------------------|----------------------------|---|--|
| 1 | 2   | 3                  | 4                          | 5   | 6  |
| 1 |   |                    |                            |   |  |
| 2 |   |                    |                            |   |  |
| 3 |   |                    |                            |   |  |



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**ASSESSMENT MATERIALS  
on the discipline**

**B1.M.13 Concepts of modern natural science**

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Assessment materials for the discipline are intended to evaluate learning outcomes in accordance with the competency achievement indicators.

Assessment of learning outcomes in the discipline is carried out within the framework of ongoing assessment (CC) and interim assessment conducted under the point-rating system (PRS).

### 1. Technological map.

Semester 1

| Section name  | Type of control | Рейтинговые показатели |                |                    |                |                     |                |       |                    |
|---|-----------------|------------------------|----------------|--------------------|----------------|---------------------|----------------|-------|--------------------|
|   |                 | I Current control      | Points for CC1 | II Current control | Points for CC2 | III Current control | Points for CC3 | Total | Interim assessment |
| <b>Section 1.</b> «Scientific cognition. Characteristics of the foundations of natural science»               | <b>CC1</b>      | 15                     | 0-15           |                    |                |                     |                | 15-30 | 15-30              |
| Test or written survey  |                 |                        | 15             |                    |                |                     |                |       |                    |
| Completion of individual assignments (essays)   |                 | 15                     |                |                    |                |                     |                |       |                    |
| <b>Section 2.</b> «Fundamental laws and concepts of natural science»  | <b>CC2</b>      |                        |                | 15                 | 0-15           |                     |                | 15-30 | 15-30              |
| Test or written survey  |                 |                        |                |                    | 15             |                     |                |       |                    |
| Completion of individual assignments (essays)   |                 |                        |                | 15                 |                |                     |                |       |                    |
| <b>Section 3.</b> «Evolutionary development of the Universe. Human as an object of natural science knowledge» | <b>CC3</b>      |                        |                |                    |                | 25                  | 0-15           | 25-40 | 25-40              |
| Control work  |                 |                        |                |                    |                | 25                  |                |       |                    |
| Test or written survey  |                 |                        |                |                    |                |                     | 15             |       |                    |
| <b>Intermediate certification (exam)</b>  | <b>AM</b>       |                        |                |                    |                |                     |                |       | 0-45               |
| In written form based on examination tickets  |                 |                        |                |                    |                |                     |                |       | 0-45               |

### 2. Assessment materials for ongoing and interim assessment.

#### Grading scale of learning outcomes for the discipline:

| Competence code | Competency indicator code | Planned learning outcomes for the discipline | Level of competency indicator formation |               |               |              |
|-----------------|---------------------------|--|---|---------------|---------------|--------------|
|                 |                           |  | High                                    | Medium        | Below average | Low          |
|                 |                           |  | from 85 to 100                          | from 70 to 84 | from 55 to 69 | from 0 to 54 |
| Grading Scale   |                           |  |   |               |               |              |

|  |  | Excellent  | Good   | Satisfactory  | Unsatisfactory  |  |
|--|--|--|--|---|---|--|
|  |  | Pass   |  |   | Fail  |  |
| <p>GPC-2 - Is able to collect, process, and analyze data necessarily for solving management tasks using modern tools and intelligent information and analytical systems.</p> | <p>GPC-2.3 - Possesses mathematical and natural science culture as part of professional and universal human culture.</p> | <b>Knowledge:</b>  |  |   |   |  |
|  |  | <p>Core concepts and laws of philosophy, historical stages of knowledge development, evolutionary stages of the development of views on the structure of the Universe and society.</p> | <p>Fully knows the core concepts and laws of philosophy, historical stages of knowledge development, and evolutionary stages of views on the structure of the Universe and society.</p>        | <p>Knows the core concepts and laws of philosophy, historical stages of knowledge development, and evolutionary stages of views on the structure of the Universe and society with errors and shortcomings.</p>    | <p>Does not fully know the core concepts and laws of philosophy, historical stages of knowledge development, and evolutionary stages of views on the structure of the Universe and society.</p>         | <p>Does not know the core concepts and laws of philosophy, historical stages of knowledge development, and evolutionary stages of views on the structure of the Universe and society.</p>          |
|  |  | <b>Skills:</b>   |  |   |   |  |
|  |  | <p>Distinguish the object and subject of different sciences and classify them based on differences in the material object or the set of objects studied.</p>                           | <p>Demonstrates all key abilities to distinguish the object and subject of different sciences and classify them based on differences in the material object or the set of objects studied.</p> | <p>Demonstrates all key abilities to distinguish the object and subject of different sciences and classify them based on differences in the material object or the set of objects studied, with minor errors.</p> | <p>Demonstrates the abilities to distinguish the object and subject of different sciences and classify them based on differences in the material object or the set of objects studied incompletely.</p> | <p>Does not demonstrate the abilities to distinguish the object and subject of different sciences and classify them based on differences in the material object or the set of objects studied.</p> |
| <b>Possess:</b>  |  |  |  |   |   |  |
| Universal  | Demonstrates   | Demonstrates skills  | Demonstr   | Does not  |   |  |

|   |   |  |   |  |  |  |
|---|---|--|---|--|--|--|
|   |   | methodology of cognition of the object and subject of research in various sciences, foundations of intercultural communication.                                      | skills of mastering the universal methodology of cognition of the object and subject of research in various sciences and the foundations of intercultural communication without errors or shortcomings. | of mastering the universal methodology of cognition of the object and subject of research in various sciences and the foundations of intercultural communication with errors and shortcomings. | ates skills of mastering the universal methodology of cognition of the object and subject of research in various sciences and the foundations of intercultural communication incompletely. | demonstrate skills of mastering the universal methodology of cognition of the object and subject of research in various sciences and the foundations of intercultural communication. |
| GPC-2.4<br>Knowledg<br>e of the<br>laws of develop<br>ment of nature,<br>society,<br>and thinkin<br>g, and the<br>ability to<br>apply this<br>knowledg<br>e in professi<br>onal activitie<br>s<br>Ability to<br>analyze and<br>evaluate<br>socially | Knowledge:  |  |   |  |  |  |
|   | Fundamental laws of individual natural science disciplines and the law of conservation of mass and energy and the ability to apply them in professional activity. | Fully knows the fundamental laws of individual natural science disciplines and the law of conservation of mass and energy and applies them in professional activity. | Knows the fundamental laws of individual natural science disciplines and the law of conservation of mass and energy and applies them in professional activity with errors and shortcomings.             | Partially knows the fundamental laws of individual natural science disciplines and the law of conservation of mass and energy and applies them in professional activity.                       | Does not know the fundamental laws of individual natural science disciplines and the law of conservation of mass and energy and does not apply them in professional activity.              |  |
|   | Skills:   |  |   |  |  |  |
|   | Construct a scientific material model of the Universe and demonstrate the contribution of various sciences to   | Correctly constructs a scientific material model of the Universe and demonstrates the  | Constructs a scientific material model of the Universe and demonstrates the contribution of various sciences to   | Constructs the model with significant errors and   | Does not demonstrate the ability to construct a scientific material model of the   |  |

|   |  |  |   |  |   |
|---|--|--|---|--|---|
| significant phenomena, events, and processes; mastery of the basic methods of quantitative analysis and modeling, theoretical | the unified scientific «tree of knowledge»; apply scientific methods in the study of objects of professional activity.                                   | contribution of various sciences to the unified scientific «tree of knowledge»; applies scientific methods in the study of objects of professional activity.                           | the unified scientific «tree of knowledge» with minor errors; applies scientific methods in research of objects of professional activity.                           | demonstrates limited understanding of the contribution of sciences to the unified scientific «tree of knowledge»; applies scientific methods only partially. | Universe or to apply scientific methods in the study of objects of professional activity.   |
|   | Own:   |  |   |  |   |
|   | Culture of thinking, ability to generalize, analyze, perceive information, set goals and choose ways to achieve them based on the available information. | Fully demonstrates skills of thinking culture, the ability to generalize, analyze, perceive information, set goals and choose ways to achieve them based on the available information. | Demonstrates a culture of thinking and the ability to generalize, analyze, perceive information, set goals, and choose ways to achieve them with some shortcomings. | Partially demonstrates a culture of thinking and the ability to generalize, analyze, perceive information, set goals, and choose ways to achieve them.       | Does not demonstrate a culture of thinking or the ability to generalize, analyze, perceive information, set goals, and choose ways to achieve them. |

The grade «**excellent**» is awarded for the completion of *individual assignments (essays) during the semester; test tasks; a control test; a deep understanding of the concepts of modern natural science; and full, well-reasoned answers to examination questions (theoretical and practical tasks).*

The grade «**good**» is awarded for the completion of *individual assignments (essays); test tasks; a control test; an understanding of the concepts of modern natural science; and answers to examination questions (theoretical or practical tasks).*

The grade «**satisfactory**» is awarded for the completion of *individual assignments (essays) during the semester; test tasks; and a control test.*

The grade «**unsatisfactory**» is awarded for weak or incomplete completion of *individual assignments (essays) during the semester, test tasks, and the control test.*

### 3. List of assessment tools.

Brief description of the assessment tools used for ongoing monitoring of students' academic performance and interim assessment in the discipline:

| Name of the assessment tool | Brief description of the assessment tool   | Description of the assessment tool |
|-----------------------------|--|------------------------------------|
| Control test                | A tool for assessing the ability to apply acquired knowledge to solve specific types of tasks within the topic or section.   | Set of control tasks by variants   |
| Essay                       | A product of the student's independent work presenting a brief written summary of the results of a theoretical analysis of a specific scientific (educational-research) topic. | Essay topics                       |
| Test                        | A system of standardized tasks that allows automation of the procedure for measuring the level of knowledge and skills of students.  | Set of test tasks                  |

### 4. List of control tasks or other materials required to assess knowledge, skills and abilities characterizing the stages of competence formation in the process of mastering the discipline.

*Example task.*

**For ongoing assessment CC1:**

Verifiable competence: GPC-2.3, GPC-2.4.

**Test for CC1:**

| Question  | Answer options  |
|---|---|
| A concept is...   | 1) a method of reasoning from the general to the particular<br>2) a specific way of understanding and interpreting phenomena<br>3) a doctrine about the laws and phenomena of nature<br>4) a method of scientific cognition |
| Establish the correspondence between the levels of scientific knowledge and their content:                                | 1) the object of the empirical level of knowledge is formed<br>2) the object of the theoretical level of knowledge is formed<br>A) as a result of idealization and formalization<br>B) through sensory experience           |
| A direction in scientific theory whose main thesis states that knowledge is possible only through experience is called... | 1) rationalism  |
|   | 2) empiricism   |
|   | 3) system approach  |
|   | 4) phenomenalism  |
| According to the principle of verification...   | 1) knowledge is scientific if it is empirically verifiable<br>2) knowledge can claim to be «scientific» if it is refutable<br>3) knowledge can claim to be «scientific» if it is in   |

|   |  |
|---|--|
|   | principle non-refutable  |
| A method of scientific cognition in which a mental or actual reconstruction of a whole from its parts is carried out is called...                   | 1) intuition<br>2) modeling<br>3) analysis<br>4) synthesis   |
| A method of scientific cognition in which the object of research is placed under specially controlled and observable conditions is called...        | 1) analogy<br>2) modeling<br>3) measurement<br>4) experiment   |
| Choose the correct answers. The concept that matter has an exclusively discrete structure is characteristic of...                                   | 1) the doctrine of ancient Greek atomists<br>2) the mechanical scientific worldview<br>3) the electromagnetic scientific worldview<br>4) the modern scientific worldview   |
| Choose the correct answers. The idea that time and space are not connected with each other and can be considered separately is characteristic of... | 1) the special theory of relativity<br>2) natural-philosophical worldviews of ancient thinkers<br>3) classical mechanics of I. Newton<br>4) the general theory of relativity   |
| In the mechanical worldview it is assumed that...   | 1) space is homogeneous, three-dimensional, Euclidean<br>2) depending on the choice of reference system the rate of time flow may differ<br>3) the properties of space differ depending on direction<br>4) space is homogeneous, curved, non-Euclidean |
| The set of successive positions occupied by a body in the process of motion is called...  | 1) equilibrium<br>2) uniformly accelerated motion<br>3) ideal motion<br>4) trajectory  |

## Report

### List of essay topics for CC1:

1. The Role of Science in Human and Social Life
2. The Structure of Scientific Knowledge
3. Natural Science as a Scientific Discipline
4. History of Natural Science
5. Scientific Ethics
6. Scientific Revolutions and Their Role in Natural Science
7. The Necessity of Time
8. Biology as a Science
9. History of the Development of Medicine
10. The Biosphere and Cosmic Cycles
11. Cloning as a Factor of Further Evolution
12. The Concept of the Noosphere and Its Role in Nature
13. The Plant and Animal World: General and Specific Features
14. Synergetics and the Manifestation of Its Laws in Nature and Society
15. The Solar System

16. Social Qualities of Personality, Norms and Values
17. The Structure of a Living Organism
18. Structural Levels of the Organization of Life
19. Structural Levels of the Organization of Matter
20. V.I.Vernadsky's Doctrine of the Biosphere
21. Human Origin
22. Human Physiology
23. Humans and Radiation
24. Human Being. Individual. Personality
25. Human Being: Emotions, Creativity, Work Capacity
26. The Evolutionary Theory of Charles Darwin
27. Self-Organization in Living and Non-Living Nature
28. Principles of Universal Evolutionism
29. The Path to a Unified Culture

**For Ongoing Assessment CC2:** Verifiable competence: GPC-2.3, GPC-2.4.

**Test for CC2:**

| Question  | Answer options   |
|---|--|
| Establish the correspondence between the principles and their content:  | 1) action at short range   |
|   | 2) action at a distance  |
|   | 3) interaction is transmitted from body to body, from point to point, with finite speed  |
|   | 4) interaction between bodies is transmitted instantly through empty space at any distance   |
| The properties of space are determined by the masses of material bodies and objects — this statement exists in... | 1) the principle of equivalence  |
|   | 2) the special theory of relativity  |
|   | 3) the general theory of relativity  |
|   | 4) Galileo's principle of relativity   |
| Democritus, Aristotle, Epicurus, and Empedocles were representatives of...  | 1) biology   |
|   | 2) Renaissance chemistry   |
|   | 3) natural philosophy  |
|   | 4) cosmology   |
| The microworld is...  | 1) the sphere of enormous cosmic scales and velocities<br>2) the world of material objects comparable in scale to humans<br>3) the domain of very small material objects that cannot be directly observed  |
| Additive properties of a chemical substance are manifested in the fact that...                                    | 1) all physical and chemical properties of a substance completely coincide with the properties of the molecules that compose it<br>2) any properties of a substance are determined by summing the properties of individual molecules<br>3) the mass of a substance equals the sum of the masses of all molecules that compose it<br>4) a substance consists of molecules, which in turn consist of atoms composed of electrons and a nucleus |

|   |   |
|---|---|
| Heliocentrism is the idea of the central place of _____ in the universe.  | <ol style="list-style-type: none"> <li>1) Earth</li> <li>2) Human beings</li> <li>3) the Sun</li> <li>4) God</li> </ol>   |
| The properties of chemical elements are not random but depend on the electronic structure of atoms and change regularly with the atomic number. This is the essence of... | <ol style="list-style-type: none"> <li>1) the law of constant composition</li> <li>2) the Van't Hoff rule</li> <li>3) the periodic law of D. I. Mendeleev</li> <li>4) Le Chatelier's principle</li> </ol> |
| Representative of the school of atomists...   | <ol style="list-style-type: none"> <li>1) Thales</li> <li>2) Democritus</li> <li>3) Francis Bacon</li> <li>4) Thomas Aquinas</li> </ol>   |

### List of essay topics for CC2:

- 1) Biosphere and noosphere.
- 2) Bioethics.
- 3) Global problems of our time.
- 4) The effect of atmospheric pollution on the human body.
- 5) The effect of pollution of the hydrosphere on the human body.
- 6) The influence of sounds and noises on human activity.
- 7) The effect of food on the human body.
- 8) Genetic engineering as a factor of further evolution.
- 9) The unity of the biological and the social in man.
- 10) Pollution of the lithosphere. Soil and man.
- 11) Concepts of human origin.
- 12) Landscape as a factor of health.
- 13) Mutations
- 14) The main problems of ecology and the role of the environment for life.
- 15) The Big Bang Theory.
- 16) Evolution of Galaxies and stars.
- 17) Basic theories of the origin of life on Earth.
- 18) Features of the Earth's structure.

**For Ongoing Assessment CC3:** Assessed competencies: GPC-2.3 – mastery of mathematical and natural science culture as part of professional and universal human culture.; GPC-2.4 – knowledge of the laws of development of nature, society, and thinking and the ability to apply this knowledge in professional activity; the ability to analyze and evaluate socially significant phenomena, events, and processes; mastery of the basic methods of quantitative analysis and modeling, as well as theoretical and experimental research.

### Test for CC3:

| Question   | Answer options  |
|--|---|
| According to modern scientific views, the Universe we observe... | <ol style="list-style-type: none"> <li>1) arose as a result of the Big Bang</li> <li>2) has always existed</li> </ol> |

|   |  |
|---|--|
|   | 3) arose as a result of divine creation  |
| As units of length for measuring distances between galaxies, scientists use...                                  | 1) parsecs   |
|   | 2) kilometers  |
|   | 3) meters  |
|   | 4) centimeters   |
| The finiteness of the size of the Metagalaxy (unlike the size of the Universe) is explained by the fact that... | 1) we can observe only those objects whose study has been possible to reach us during the lifetime of the Universe<br>2) during cosmological expansion the Metagalaxy has not yet become infinitely large<br>3) cosmological expansion is not observed on the scale of the Metagalaxy<br>4) according to Einstein's cosmological model, space-time has a constant positive curvature similar to a sphere |
| Choose the correct answers. Mandatory characteristics (attributes) of a planet include...                       | 1) rotation around a star<br>2) spherical shape<br>3) thermonuclear reactions occurring in its interior<br>4) a large number of stars included in its composition  |
| According to modern cosmology, the age of the Universe is...  | 1) 3 billion years<br>2) 4.5 billion years<br>3) 5 billion years<br>4) 12–15 billion years   |
| Match the concepts of the origin of life on Earth with their meanings:  | 1) Panspermia A) Divine creation<br>2) Creationism B) life brought from space<br>3) Steady-state theory C) life has always existed   |
| An ecosystem is synonymous with the term...   | 1) population<br>2) biocenosis<br>3) biogeocenosis<br>4) biosphere   |
| Match the concept with its definition:  | 1) heterotrophs A) organisms that use inorganic sources for their nutrition<br>2) autotrophs B) return substances from dead organisms back into the nonliving environment<br>3) decomposers C) organisms that feed on ready-made organic substances  |

### Control work for CC3.

#### Example tasks for the control work.

**№1.** Provide examples of general scientific methods of cognition: observation, measurement, analysis, synthesis, induction, deduction, comparison, generalization, analogy, abstraction, modeling.

**№2.** Fill in the table in the workbook. What ideas about the fundamental concepts of classical physics prevailed in these 4 worldviews?

| Fundamental concepts of classical physics | Mechanical worldview | Thermodynamic worldview | Electromagnetic worldview | Quantum-field worldview |
|---|----------------------|-------------------------|---------------------------|-------------------------|
| Matter                                    |                      |                         |                           |                         |

|             |  |  |  |  |
|-------------|--|--|--|--|
| Motion      |  |  |  |  |
| Space       |  |  |  |  |
| Time        |  |  |  |  |
| Interaction |  |  |  |  |

**№3.** Fill in the table in your workbook.

| Name of the science | Etymology | Period of formation as a science | Scientists who contributed to the science | Major discoveries |
|---------------------|-----------|----------------------------------|---|-------------------|
| Physics             |           |                                  |   |                   |
| Chemistry           |           |                                  |   |                   |
| Biology             |           |                                  |   |                   |
| Geology             |           |                                  |   |                   |
| Geography           |           |                                  |   |                   |
| Ecology             |           |                                  |   |                   |
| Cosmology           |           |                                  |   |                   |
| Astronomy           |           |                                  |   |                   |
| Cosmogony           |           |                                  |   |                   |

**№4.** Fill in the table in your workbook.

| Criteria of distinction                                     | Natural sciences | Humanities |
|---|------------------|------------|
| 1. Object of study  |                  |            |
| 2. Main function  |                  |            |
| 3. Nature of methodology                                    |                  |            |
| 4. Influence of values                                      |                  |            |
| 5. Anthropocentrism   |                  |            |
| 6. Ideological influence                                    |                  |            |
| 7. Relationship between the subject and object of cognition |                  |            |
| 8. Quantitative–qualitative characteristics                 |                  |            |
| 9. Application of experimental methods                      |                  |            |
| 10. Nature of the object of study                           |                  |            |

**№5.** Essay topic: «The Origin of the Universe». What do you think: how did our Universe form, and what scenario of its future development do you assume?

**№6.** Presentation of an Essay on the Topics:

1. Galaxies
2. Stars
3. The Milky Way
4. The Solar System
5. Planet Mercury
6. Planet Venus
7. Planet Earth

8. Planet Mars
9. Planet Jupiter
10. Planet Saturn
11. Planet Uranus
12. Planet Neptune
13. Pluto
14. Comets
15. Meteorites

**№7.** An essay on the topic: «The origin of life on Earth as a phenomenon». What is your concept of the origin of life on Earth?

**№8.** In your workbook, provide examples of biotic interactions:

- Neutralism
- Competition (intraspecific and interspecific)
- Parasitism
- Predation
- Mutualism
- Commensalism
- Symbiosis

**№9.** In your workbook, describe global environmental problems and ways to solve them (atmosphere, hydrosphere, lithosphere, biosphere).

**№10.** An essay on the topic: «The Origin of Man». Which concept of human origin do you support?

**№11.** Presentation of an essay on the topic: «Anthropogenesis».

**№12.** An essay on the topic: «I Believe That I Am a Personality».

**№13.** An essay on the topic: «The Human of the Future». Describe your model of the future Human:

- will Humans change from a biological point of view? Describe what changes may occur;
- will moral and cultural values change?

**For the interim assessment:**

List of examination questions:

1. The history of the emergence and the main features of natural science. Characteristics of the four stages of the cognition of Nature (the Universe).
2. Scientific revolutions.

3. General characteristics of the state and the main problems of modern natural science.
4. Science in the system of different levels of knowledge.
5. Problems of subordination, classification, reductionism and leadership in the relations between different sciences.
6. The problem of reductionism of physics in relation to other sciences, using attempts to reduce chemistry to physics as an example.
7. Characteristics of the features of natural-scientific and humanitarian culture.
8. Main problems in the evolution of materialistic views on the structure of the Universe and modern natural science as a whole.
9. Basic concepts of natural science and their definitions (Nature, Universe, the Universe as a whole, Matter and its varieties) and the subject of research (composition, type of connection, structure, properties) in natural science. Modern definition of natural science.
10. Traditional classification of sciences, its shortcomings and the place of natural science (including mathematics and philosophy) in the modern system of scientific knowledge.
11. Classification of levels of knowledge about material objects of the Universe.
12. The concept of fundamentality of knowledge as a characteristic of the type of connection, structure and properties of the studied objects considered as closed material systems. Objective and subjective knowledge.
13. General characteristics, features and criteria of scientific knowledge.
14. Forms, composition and structure (scientific fact, regularities, scientific picture of the Universe) of scientific knowledge.
15. Features of the fundamental (theoretical) and applied (practical) components of various sciences.
16. Method and sequence of concepts revealing the universal methodology of scientific cognition of material objects in natural science.
17. General characteristics of the process of natural-scientific cognition (sensations, images, concepts, representations; methods of comparison, analysis, synthesis, induction, deduction, etc.).
18. Matter: its fundamental characteristics determining the forms and varieties of material objects existing in the Universe, their structure and properties.
19. Field, substance, material body – unity of nature and differences in structure and properties.
20. Features of the corpuscular – continuum (discrete–continuous) existence of material objects in the Universe and their wave properties (the de Broglie equation and its components).
21. Space–time characteristics of material objects and the Universe as a whole. Definitions of space and time and their properties.
22. Order and disorder in Nature; chaos and the principle of symmetry of material systems.
23. Thermodynamics and the principle of increasing entropy.

24. Reactivity of substances.
25. Varieties of interactions of material objects and their classification (types and varieties).
26. Types of motion of material objects (fields, substances and material bodies) in the Universe.
27. General characteristics of types of interactions of elements forming different levels of the structural organization of matter (physical nuclear and electromagnetic, chemical, mechanical, gravitational, etc.) and types of closed material systems.
28. Short-range and long-range interactions between elements forming various material systems.
29. Classification of substances by differences in composition and type of connection between their constituent elements.
30. Scheme of transformation and increasing complexity of the structure of substances at the physical, chemical, biological and other levels of structural organization and the nature of changes in their size – mass characteristics.
31. General characteristics of the movements and transformations of material objects (the circulation of substances in nature) as the basis of the evolutionary development of the Universe.
32. The principle of relativity, using the effect of the speed of light on the passage of time as an example.
33. Evolution of views on the structure of matter and the universality of applying the triad «composition and type of interaction – structure – properties» to the study of any material object.
34. The paradigm and system of the multi-level organization of matter and objects of the Universe (Nature) and their classification. The place of various material objects and humans in the Universe system within the sequence: ultra-micro, micro, macro and megaworlds.
35. Composition and structure of the Universe.
36. General characteristics of changes in composition, structure and properties of material objects (elements) forming Universe systems as they transition along the sequence: ultra-micro, micro, macro and megaworlds.
37. Laws of conservation and transformation: energy (the first law of thermodynamics, etc.); mass and energy (mass defect using the example of the difference between the sum of masses of protons and neutrons (nucleons) and the mass of the atomic nucleus) and others.
38. Integral (general) laws of the Universe.
39. Synergetics as a theory of self-organization and the transition of open nonequilibrium systems to more complex ordered states.
40. Features of the modern natural-scientific worldview within the Universe system and the natural-scientific universal classification of sciences by the type of material object studied in each of them.
41. Problems of the origin and evolution of the Universe. The Big Bang theory.
42. General characteristics of ultra-microworld objects (electromagnetic and

other types of fields).

43. General characteristics of microworld objects, their division into three sublevels (physical, chemical and early biological forms of matter) and the scheme of increasing complexity of material particles – substances of this level of the Universe.

44. Classification of elementary particles (individual elementary physical substances).

45. Fundamentals of the quantum-mechanical (wave–particle dualism) concept describing the smallest particles of matter of the microworld (Einstein’s quantum/photon theory, Schrödinger equation, de Broglie hypothesis, etc.).

46. Characteristics (composition, type of bonds, structure) and classification of atoms (individual physical substances – compounds of elementary particles).

47. The periodic system of atoms of D. I. Mendeleev and its characteristics.

48. Formulation of D. I. Mendeleev’s periodic law as a differentiated fundamental law of Nature.

49. Specific features of the composition, type of bonds, structure and properties of chemical substances (chemical compounds of elements).

50. Chemical substances, their transformations, cycles and role in the evolution of the Earth, including the emergence of living organisms and humans.

51. Chemistry in human life support (energy, materials, nutrition, etc.) of humanity.

52. General characteristics (composition, type of bonds and spatial structure) of the main classes of chemical compounds of elements (chemical substances).

53. Three types of chemical bonds between elements and a unified model explaining them.

54. System of chemical bonds and compounds and basic chemical substances and materials as the foundation for understanding their fundamental unity and the diversity of structures and properties of material objects.

55. General classification of basic chemical compounds and the specifics of structures and properties of their main classes, types, groups, etc., based on their position in the system of chemical bonds and compounds.

56. Inorganic objects of the micro- and macroworlds (inorganic chemical substances, minerals and geosystems) forming the material basis of the atmosphere, hydrosphere and lithosphere of the Earth, as well as the environment for the formation, life and evolution of biosphere objects.

57. The chemical basis for dividing matter into its living and non-living forms.

58. Specific features of the biospheric level of organization of matter and the elements that compose it.

59. Features of the structure and varieties of the cellular level of living matter.

60. Biological evolution and genetics.

61. The position of the Earth in the system of the multi-level organization of the Universe; the main types of matter and their components and the general characteristics of the structural organization of the atmosphere, lithosphere,

hydrosphere, biosphere, etc.

62. Describe the structure of the Earth and the spheres composing it.

63. List the main elements and substances forming the micro- and macrostructure of the Earth.

64. List the substances forming the lithosphere of the Earth and their proportions.

65. The mineralogical level of the structural organization of matter.

66. List the substances forming the hydro- and atmosphere of the Earth and their proportions.

67. Biological objects of the micro- and macroworlds of the Universe system, including humans.

68. Humans as a constituent part of Nature. Humans in the world of Earth (problems of interaction between humans and the environment, ecology, etc.).

69. Concepts of the origin of life on Earth; features of anthropogenesis and human evolution.

70. The noosphere and the ideas of V. I. Vernadsky.

71. The technosphere, technosphere ecology and problems of environmental safety.

72. Material objects of the megaworld and general characteristics of their structure and properties.

73. Structure of the Solar System and the elements that compose it.

74. Comparative characteristics of the main planets of the Solar System.

75. Laws of classical mechanics of Newton (inertia, acceleration, universal gravitation of material bodies, etc.) of the megaworld.

76. General characteristics of the Sun.

77. Features of the position of the Earth in the Solar System and the material causes of the emergence of life on it.

78. The galactic level of organization of material planetary systems.