KSPEU

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.08 Industrial ecology

Field of training 38.03.02 Management

Qualification Bachelor's Degree

Kazan, 2026

The program was developed(and):

Name of the department	Position, academic degree, academic title	Developer's full name
Environmental engineering and occupational safety	senior teacher	Serazeeva E.V.

Agreement	Division name	Date	№ protocol	Signature
Approved	IE	22.01.2026	№1	_____ Head of Department, Doctor of Technical Sciences, Prof.Nikolaeva L. A.
Agreement	Management	10.02.2026	Protocol №5	_____ Head of the Department, Doctor of Social Sciences, Professor. Makhiyanova A.V.
Agreement	Educational and Methodological Council of the ITCE	24.02.2026	Protocol №6	_____ Director, PhD, Associate Professor Belyaev E.I.
Approved	The Scientific Council of the ICTE	24.02.2026	Protocol №6	_____ Director, PhD, Associate Professor Belyaev E.I.

1. The purpose, objectives and planned learning outcomes of the discipline

The purpose of the discipline "Industrial Ecology" is to form students' basic ideas about the main theoretical and applied directions in ecology, as well as a system of understanding the processes occurring in the environment, as a basis for solving problems in the field of rational environmental management, as well as the ability to apply theoretical knowledge to solve environmental problems.

The objectives of the discipline are as follows:

- familiarization with the system of scientifically substantiated engineering and technical measures aimed at preserving the quality of the environment in the context of growing industrial production;
- development of an environmental protection worldview, due to the current state of the human habitat, the significant negative contribution of industrial production to the state of the biosphere;
- study of the main global and regional problems of our time;
- study of the existing methods of reducing the negative impact of industrial production on the environment;
- acquisition of practical skills in solving problems of improving the environmental friendliness of production processes.

Competencies and indicators that students acquire:

Competence code and name	Indicator code and name
UC-2 Able to define a range of tasks within the scope of a given goal and select the best ways to accomplish them, based on applicable legal norms, available resources, and constraints	UC-2.2 Selects the optimal method for solving problems, taking into account applicable legal norms and existing conditions, resources, and limitations
UC-8 Able to create and maintain safe living conditions in everyday life and professional activities to preserve the natural environment and ensure the sustainable development of society, including in the event of threats and emergencies and military conflicts	UC-8.1 Identifies potential threats to human life and health in everyday life and professional activities, creates and maintains safe conditions to ensure the sustainable development of society

2. The place of the discipline in the curriculum structure

Pre-requisites (modules), practices, research, etc.

Subsequent disciplines (modules), practices, research projects, etc. UK-8.1 Life Safety.

3. Structure and content of the discipline

3.1. Structure of the discipline

For full-time education

Type of educational work	Total ZE	Total hours	Term
			3
TOTAL LABOR INTENSITY OF THE DISCIPLINE	2	72	72
CONTACT WORK *	-	40	40
CLASSROOM WORK	1	36	36
Lectures	0,5	18	18
Practical (seminar) classes	0,5	18	18
Laboratory work	-	-	-
STUDENT'S INDEPENDENT WORK	1	36	36
Study of educational material	1	36	36
Course project	-	-	-
Course paper	-	-	-
Preparation for the intermediate certification	0	0	0
Intermediate certification:			Z
			-

3.2. The content of the discipline, structured by sections and types of activities

Discipline sections	Total hours	Distribution of labor intensity by types of educational work				Forms and type of control	Indices of indicators of formed competencies
		lectures	lab. slave.	zan ave..	myself. a slave.		
Chapter 1	24	6	-	6	12	LC 1	UK -2.2 3
Chapter 2	24	6	-	6	12	LC 2	UK -2.2 U; UK -8.1 U
Chapter 3	24	6	-	6	12	LC 3	UK -2.2 U; UK -8.1 Own
Test	0				0	**OM 1**	**UK -2.2** U**; UK -8.1 Own**
Total for 3 semesters	**72**	**18**		**18**	**36**		
TOTAL	**72**	**18**		**18**	**36**		

3.3. Content of the discipline

Section 1. The current ecological state of the habitat.

Topic 1.1. Sources of pollution, the main pollutants and approaches to the regulation of environmental pollution.

Natural and technical ecological systems. Technogenic pollution of the habitat. The current ecological crisis: features and causes. Global consequences of anthropogenic impact on the habitat.

Topic 1.2. Environmental safety management systems.

The concept and types of environmental impact assessments, the

environmental control system in Russia, environmental licensing and certification. Assessment of the impact of proposed economic activities on the environment. Environmental certification of natural resource users.

Section 2. Main directions of rational nature management and environmental protection.

Topic 2.1. Methods of minimizing anthropogenic impact on the environment.

The main environmental pollutants, classification of systems and methods of purification from pollutants, and indicators of their effectiveness. Ecologization of technological processes and optimization of the location of pollution sources.

Раздел 3. Концепция развития малоотходного и безотходного производств.

Topic 3.1. Low-waste and resource-saving technologies

Definition and concept of waste-free production. Principles of waste-free production. Main directions of development of low- and waste-free production. The principle of complex use of raw materials. Technological principles of waste reduction. Creation of closed water-recycling systems of the enterprise.

3.4. Thematic plan of practical classes

1. Calculation of the fee for the use of natural resources.
2. Calculation of the maximum concentration of harmful substances in the release of a heated gas-air mixture from a single point source.
3. Evaluation of the efficiency of capturing industrial emissions.
4. Calculation of air pollution by vehicle emissions.
5. Calculation of VAT for a flowing reservoir.
6. Calculation of the characteristics of wastewater discharges from enterprises into reservoirs.
7. Calculation of the enterprise's hazard category, depending on the mass and nomenclature of pollutants emitted into the atmosphere.
8. Electromagnetic pollution of the environment. Calculation of the SSS.
9. Calculation of the sump.
10. Calculation of the cyclone.
11. Calculation of the volume of waste generation.
12. Monitoring systems and tools. Environmental management tasks.

3.5. Thematic plan of laboratory work

This type of work is not provided for in the curriculum.

3.6. Course project / course work

This type of work is not provided for in 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 certification, carried out according to the point-rating system (PRS).

The scale of assessment of learning outcomes in the discipline:

Competence code	Competence indicator code achievement	Planned learning outcomes by discipline	The level of competence development (indicator of competence achievement)			
			Tall	Average	Below average	Low
			от 85 до 100	от 70 до 84	от 55 до 69	от 0 до 54
			Assessment scale			
			excellent	good	satisfactory	satisfactory
			credited			not counted
UC-2 Able to define a range of tasks within the scope of a given goal and select the best ways to accomplish them, based on applicable legal norms, available resources, and constraints	UC-2.2 Selects the optimal method for solving problems, taking into account applicable legal norms and existing conditions, resources, and limitations	To know				
		basic principles of environmental safety, rational nature management, and energy and resource conservation	Knows the basic principles of environmental safety, rational nature management, and energy and resource conservation without any shortcomings	Knows the basic principles of environmental safety, rational nature management, and energy and resource conservation, with some shortcomings	Knows the basic principles of environmental safety, rational nature management, and energy and resource conservation, with numerous errors and shortcomings	Does not know the basic principles of environmental safety, rational nature management, and energy and resource conservation

		regulatory framework and main directions of state policy in the field of environmental protection, energy and resource conservation	Knows the regulatory framework and the main directions of state policy in the field of environmental protection, energy and resource conservation	Knows the regulatory framework and the main directions of state policy in the field of environmental protection, energy and resource conservation, with some shortcomings	Knows the regulatory framework and the main directions of state policy in the field of environmental protection, energy and resource conservation, with numerous errors and shortcomings	Does not know the legal framework and the main directions of state policy in the field of environmental protection, energy and resource conservation
		modern methods and means of environmental protection	Knows modern methods and tools for environmental protection without any flaws	Knows modern methods and means of environmental protection with some shortcomings	Knows modern methods and tools for environmental protection with numerous errors and shortcomings	Does not know modern methods and tools for protecting the environment
		economic aspects of environmental protection	Knows the economic aspects of environmental protection without any shortcomings	Knows the economic aspects of environmental protection with some shortcomings	Knows the economic aspects of environmental protection with numerous errors and shortcomings	Does not know the economic aspects of environmental protection
		Be able to				

		assess the potential danger of an object in terms of its impact on the environment;	He is able to assess the potential danger of an object in terms of its environmental impact without any flaws.	He is able to assess the potential danger of an object in terms of its environmental impact, with some minor drawbacks.	He is able to assess the potential danger of an object in terms of its environmental impact, with numerous errors and shortcomings.	Does not know how to assess the potential danger of an object in terms of its impact on the environment;
		select methods for cleaning industrial emissions, discharges, and waste recycling and disposal based on an analysis of scientific and technical	He is able to select methods for cleaning industrial emissions, discharges, and waste recycling and disposal based on an analysis of scientific and technical literature.	He is able to select methods for cleaning industrial emissions, discharges, and waste recycling and disposal based on an analysis of scientific and technical literature with certain shortcomings.	He is able to select methods for cleaning industrial emissions, discharges, and waste recycling and disposal based on an analysis of scientific and technical literature with numerous errors and shortcomings	Does not know how to select methods for cleaning industrial emissions, discharges, and waste recycling and disposal based on the analysis of scientific and technical literature

		make decisions taking into account the possible environmental impact of facilities and the requirements of energy and resource conservation	He is able to make decisions taking into account the possible environmental impact of facilities and the requirements of energy and resource conservation based on the existing regulatory framework without any shortcomings	He is able to make decisions taking into account the possible environmental impact of facilities and the requirements for energy and resource conservation based on the existing regulatory framework, which has some shortcomings.	He is able to make decisions taking into account the possible environmental impact of facilities and the requirements for energy and resource conservation based on the existing regulatory framework, which contains numerous errors and shortcomings.	He is unable to make decisions taking into account the possible environmental impact of facilities and the requirements of energy and resource conservation based on the existing regulatory framework.
		Own				
		skills in using environmental knowledge in everyday life and at work	Possesses the skills to use environmental knowledge in everyday life and at work without any shortcomings	Possesses skills in using environmental knowledge in everyday life and at work, with some shortcomings	Possesses skills in using environmental knowledge in everyday life and at work, with numerous errors and shortcomings	Does not have the skills to use environmental knowledge in everyday life and at work
		terminology in the field of environmental protection, rational nature management, energy and resource conservation	Proficient in environmental protection, sustainable development, energy and resource conservation	He is familiar with terminology in the field of environmental protection, rational nature management, and energy and resource conservation, but there are some shortcomings.	He knows the terminology in the field of environmental protection, rational nature management, and energy and resource conservation, but there are numerous errors and shortcomings.	Does not possess terminology in the field of environmental protection, rational nature management, energy and resource saving

		the main approaches to assessing environmental quality and the effectiveness of environmental measures.	Knows the basic approaches to assessing environmental quality and the effectiveness of environmental measures without any shortcomings	He is familiar with the basic approaches to assessing environmental quality and the effectiveness of environmental measures, with some shortcomings	He has a basic understanding of the approaches to assessing environmental quality and the effectiveness of environmental measures, but there are numerous errors and shortcomings.	Does not possess basic approaches to assessing environmental quality and the effectiveness of environmental measures
UC-8	UC-8.1	To know				

Able to create and maintain safe living conditions in everyday life and professional activities to preserve the natural environment and ensure the sustainable development of society, including in the event of threats and emergencies and military conflicts	Identifies potential threats to human life and health in everyday life and professional activities, creates and maintains safe conditions to ensure the sustainable development of society	possible threats to human life and health, as well as methodological, regulatory, and guidance materials related to professional activities	Knows the possible threats to human life and health, as well as the methodological, regulatory, and guidance materials related to professional activities without any flaws	Knows the possible threats to human life and health, as well as the methodological, regulatory, and guidance materials related to professional activities with certain shortcomings	Knows the possible threats to human life and health, as well as the methodological, regulatory, and guidance materials related to professional activities with numerous errors and shortcomings	Does not know the possible threats to human life and health, as well as the methodological, regulatory, and guidance materials related to professional activities
		main characteristics of natural and man-made environments	Knows the basic characteristics of natural and technogenic environments without any flaws	Knows the basic characteristics of natural and technogenic environments with certain shortcomings	Knows the basic characteristics of natural and technogenic environments with numerous errors and shortcomings	Does not know the basic characteristics of natural and technogenic environments
		be able to				

		to develop methodological and regulatory materials, technical documentation, and to create and maintain safe conditio	He is able to develop methodological and regulatory materials, technical documentation, and create and maintain safe conditions for ensuring sustainable development of society without any shortcomings.	He is able to develop methodological and regulatory materials, technical documentation, and create and maintain safe conditions for ensuring sustainable development of society with certain shortcomings.	He is able to develop methodological and regulatory materials, technical documentation, and create and maintain safe conditions for ensuring sustainable development of society with numerous errors and shortcomings.	He is unable to develop methodological and regulatory materials, technical documentation, and create and maintain safe conditions for ensuring sustainable development of society.
		identify possible threats to human life and health in everyday life and in professional activities	He is able to identify possible threats to human life and health in everyday life and in professional activities without any mistakes.	He is able to identify possible threats to human life and health in everyday life and in professional activities with certain shortcomings.	He is able to identify possible threats to human life and health in everyday life and in professional activities with numerous errors and shortcomings	He is unable to identify possible threats to human life and health in everyday life and in his professional activities.
		own				

		methods of theoretical research related to the development and implementation of environmental protection and resource-saving measures, various types of new environmental protection equipment, environ	He/she is proficient in the methods of theoretical research related to the development and implementation of environmental protection and resource-saving measures, various types of new environmental protection equipment, environmentally friendly or low- and non-waste technological processes, production facilities, and production complexes without any shortcomings.	He/she is familiar with the methods of theoretical research related to the development and implementation of environmental protection and resource-saving measures, various types of new environmental protection equipment, environmentally friendly or low-waste technological processes, and production facilities with certain shortcomings.	He is proficient in theoretical research methods related to the development and implementation of environmental protection and resource-saving measures, various types of new environmental protection equipment, environmentally friendly or low-waste technological processes, and production facilities with numerous errors and shortcomings.	Does not possess the methods of theoretical research related to the development and implementation of environmental protection and resource-saving measures, various types of new environmental protection equipment, environmentally friendly or low- and non-waste technological processes, production facilities, and production units

The assessment materials for conducting current control and intermediate certification are provided in the Appendix to the working program of the discipline.

The full set of tasks and materials required for evaluating the learning outcomes of the discipline is stored at the developer's department.

5. Educational and informational support for the discipline

5.1. Educational and methodological support

5.1.1. Basic literature

1. Industrial Ecology: Textbook / A. V. Sheloumov, A. A. Leonovich. - St. Petersburg: SPbGLTU, 2018. - 92 p. - URL: https://e.lanbook.com/book/113326. - ISBN 978-5-9239-1089-6. - Text: electronic.

2. Ecology: Textbook for Universities / V. I. Korobkin, L. V. Peredelsky, O. E. Prikhodchenko. - 12th edition, expanded and revised. - Rostov-on-Don: Phoenix, 2007. - 512 p.

3. Kolesnikov, S. I., Ecology: Textbook / S. I. Kolesnikov. — Moscow: KnoRus, 2020. — 449 p. — ISBN 978-5-406-07269-1. — URL: https://book.ru/book/932296. — Text: electronic.

4. Kolesnikov, S. I., Applied Ecology: Textbook / S. I. Kolesnikov. — Moscow: KnoRus, 2021. — 277 p. — ISBN 978-5-406-08152-5. — URL: https://book.ru/book/939215. — Text: electronic.

5.1.2. Additional literature

1. Industrial Ecology: A Textbook for Universities / T. E. Gridel, B. R. Allenby; translated from English by E. V. Girusov. Moscow: UNITY, 2004. - 527 p. - (Foreign Textbook). ISBN 5-238-00620-9. - Text: direct.

2. Industrial Ecology. Engineering Protection of the Biosphere from the Impact of Air Transport: A Textbook for Universities / N. E. Nikolaykina, N. I. Nikolaykin, and A. M. Matyagina. - Moscow: Akademkniga Publishing House, 2006. - 239 p. : ill. - ISBN 5-94628-225-5.

3. Ecology : textbook / V. N. Bolshakov, V. V. Kachak, V. G. Kobernichenko [et al.] ; edited by Yu. G. Yaroshenko, G. V. Tyagunov. Moscow : KnoRus, 2018. 301 p. (Bachelor's degree). — ISBN 978-5-406-05037-8-E-2019. — URL: https://book.ru/book/932295. — Text: electronic.

5.2. Information support

5.2.1. Electronic and Internet resources

1. LMS Moodle. Electronic course "Ecology". Link https://lms.kgeu.ru/course/view.php?id=795

5.2.2. Professional databases / Information and reference systems

1. Ministry of Natural Resources and Ecology of the Russian Federation. [Electronic resource]. – Access mode: http://www.mnr.gov.ru/

2. Encyclopedias, dictionaries, and reference books. [Electronic resource]. – Access mode: http://www.rubricon.com.

3. Open Education Portal. [Electronic resource]. – Access mode: http://npoed.ru.

5.2.3. Licensed and freely distributed software of the discipline

1. Windows 7 Professional (Pro). CJSC "SoftLineTrade" No. 2011.25486 dated 28.11.2011 Non-exclusive. right. Perpetual.

2. Windows 10. LLC "Softline Trade" No. Tr096148 dated 29.09.2020 Non-exclusive. right. Until 09/14/2021.

3. Chrome browser. The free license is not exclusive. right. Indefinitely.

4. The Firefox browser. The free license is not exclusive. right. Indefinitely.

5. Adobe Flash Player. The free license is not exclusive. right. Indefinitely.

6. Adobe Acrobat. The free license is not exclusive. right. Indefinitely.

6. Material and technical support for the discipline

Name of the type of educational work	Name of the classroom, specialized laboratory	List of necessary equipment and technical training facilities
Lectures	Lecture hall D-502, D-504	Specialized educational furniture, technical teaching aids used to present educational information to a large audience (multimedia projector, computer (laptop), screen), demonstration equipment, and visual aids
Practical exercises	Training room for seminar-type classes, group and individual consultations, current control, and intermediate certification D-528	Specialized educational furniture, technical teaching aids (multimedia projector, computer (laptop), screen), etc.
Independent work	Computer class with Internet access B-600a	Specialized teaching furniture for 30 seats, 30 computers, technical teaching aids (multimedia projector, computer (laptop), screen), video cameras, and software
	Library Reading Room	Specialized furniture, computer equipment with Internet access and EIOS access, screen, multimedia projector, and software

7. Features of organizing educational activities for people with disabilities and the disabled

Persons with disabilities (PWD) and disabled people have the opportunity to move freely from one educational and laboratory building to another, to climb all the floors of educational and laboratory buildings, and to study in educational and other premises, taking into account the specifics of their psychophysical development and health conditions.

For the education of persons with disabilities and disabled people with impairments of the musculoskeletal system, conditions of unhindered access to all educational premises are provided. Information about the special conditions created for students with disabilities and disabled people is available on the university website www//kgeu.ru. It is possible to provide technical assistance by an assistant, as well as the services of sign language interpreters and deaf-blind interpreters.

To adapt to the perception of persons with disabilities and hearing impaired persons of the reference, educational material on the discipline, the following conditions are provided:

- for better orientation in the classroom, signals are used to announce the beginning and end of the lesson (the word "bell" is written on the blackboard

- the teacher draws the attention of a student with a hearing impairment by using a gesture (putting a hand on the student's shoulder and gently tapping it);

- when speaking to the student, the teacher looks at the student and speaks clearly in short sentences, ensuring that the student can read lips.

To compensate for the difficulties in speech and intellectual development of students with hearing impairments, the following methods are used:

- using diagrams, charts, drawings, and computer presentations with hyperlinks that provide commentary on specific components of the image;
- regularly using exercises that involve graphically highlighting the essential features of objects and phenomena;
- providing the opportunity for students to receive targeted consultations by e-mail as needed.

To adapt to the perception of persons with disabilities and visually impaired persons of the reference, educational, and educational material provided by the educational program for the selected field of training, the following conditions are provided:

- the official website on the Internet is adapted to the special needs of visually impaired persons, and large-print reference information about the schedule of academic classes is provided;
- the teacher and their interlocutor (if necessary), who are present at the lesson, are introduced to the students, and the teacher's name is mentioned each time;
- the teacher's actions, gestures, and movements are briefly and clearly explained;
- printed information is provided in large print (18 points or more) and is fully audible;
- the necessary level of lighting in the classrooms is ensured;
- students have the opportunity to use computers during classes and can record explanations on a voice recorder (if desired).

The form of current and intermediate assessment for students with disabilities is determined by the teacher in accordance with the curriculum. If necessary, students with disabilities are given the opportunity to pass intermediate assessment orally, in writing on paper, in writing on a computer, in the form of testing, etc., or are given additional time to prepare their answers.

8. Guidelines for teachers on organizing educational work with students

Methodological support for the educational process is one of the defining factors for high-quality education. A university teacher, demonstrating high professionalism, erudition, a clear civic position, self-discipline, and a creative approach to solving professional problems, contributes to the formation of a harmonious personality during the educational process.

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

- methods of forming an individual's consciousness (conversation, debate, suggestion, instruction, control, explanation, example, self-control, story, advice, persuasion, etc.);
- methods of organizing activities and forming behavioral experience (task, public opinion, pedagogical requirement, assignment, training, creating educational situations, training, exercise, etc.);

- methods of motivating activity and behavior (approval, encouragement of social activity, reprimand, creation of success situations, 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, state, spiritual, moral and socio-cultural values adopted in the family and society, for national, cultural and historical heritage, formation of the desire for its preservation and development;
- formation of an active civic position in students based on the traditional cultural, spiritual and moral values of Russian society, in order to increase the ability to responsibly exercise their constitutional rights and obligations;
- development of the 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-government, socially significant activities;
- the formation of motives, moral and semantic attitudes of the individual, which make it possible to resist extremism, xenophobia, discrimination on social, religious, racial, national grounds, interethnic and interfaith intolerance, and other negative social phenomena.

Spiritual and moral education:

- education 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, the spirit of mercy and compassion, the habit of caring for people in difficult life situations;
- building solidarity and a sense of social responsibility towards people with disabilities, overcoming psychological barriers towards people with disabilities;
- the formation of an emotionally rich and spiritually elevated attitude towards the world, the ability and ability to convey their aesthetic experience to others.

Cultural and educational education:

- formation of aesthetic picture of the world;
- formation of respect for the cultural values of the native city, region, country;
- increased cognitive activity of students.

Scientific and educational education:

- formation of a scientific worldview among students;
- formation of knowledge acquisition skills;
- formation of skills of information analysis and synthesis, including in the professional field.

Changes and approvals for the new academic year

№ n/a	No . of the modification	Date of changes	The content of the changes	"Approved" Head of the Department of the discipline	"Approved" Chairman of the Academic Committee of the Institute (Faculty), which includes the graduating
1	2	3	4	5	6
1					
2					
3					

Appendix to the course syllabus

KSPEU

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»)

ASSESSMENT MATERIALS
for the discipline

B1.M.08 Industrial ecology

Kazan, 2026

Assessment materials for the discipline Industrial Ecology are intended for assessing the learning outcomes for compliance with the indicators of achievement of competencies.

Assessment of the learning outcomes for the discipline is carried out within the framework of the current control (TC) and intermediate certification, carried out according to the point-rating system (PRS).

1.Technological map

Term _3__

Section name	Forms and type of control	Rating indicators							
		I Current control	Additional points for TC1	II Ongoing monitoring	Additional points for TC2	III Ongoing	Additional points for TC3	Total	Intermediate certification
Section 1. "Current Environmental Conditions"	**CC1**	**15**	**0-15**					**15-30**	**15-30**
Test or oral interview		7							
Protection of practical work		4							
Independent Work Report		4							
Section 2. "Main Directions of Sustainable Natural Resource Management and Environmental Protection"	**CC2**			**15**	**0-15**			**15-30**	**15-30**
Test or oral interview				7					
Protection of practical work				4					
Independent Work Report				4					
Section 3. "Concept of Low-Waste and Zero-Waste Production"	**CC3**					**25**	**0-15**	**25-40**	**25-40**
Test or oral interview						7			
Protection of practical work						4			
Independent Work Report						14			
Intermediate certification (pass)	**EM**								**0-45**
The task of the interim assessment									0-15
Verbally on the following issues									0-30

2. Assessment materials for current control and intermediate certification

Assessment scale for learning outcomes in the discipline:

Competence code	Competence achievement indicator code	Planned learning outcomes by discipline	The level of competence development (indicator of competence achievement)			
			Tall	Average	Below average	Low
			от 85 до 100	от 70 до 84	от 55 до 69	от 0 до 54
			Assessment scale			
			excellent	good	satisfactory	satisfactory
			credited			not counted
UC-2 Able to define a range of tasks within the scope of a given goal and select the best ways to accomplish them, based on applicable legal norms, available resources, and constraints	UC-2.2 Selects the optimal method for solving problems, taking into account applicable legal norms and existing conditions, resources, and limitations	To know				
		basic principles of environmental safety, rational nature management, and energy and resource conservation	Knows the basic principles of environmental safety, rational nature management, and energy and resource conservation without any shortcomings	Knows the basic principles of environmental safety, rational nature management, and energy and resource conservation, with some shortcomings	Knows the basic principles of environmental safety, rational nature management, and energy and resource conservation, with numerous errors and shortcomings	Does not know the basic principles of environmental safety, rational nature management, and energy and resource conservation
		regulatory framework and main directions of state policy in the field of environmental protection, energy and resource conserv	Knows the regulatory framework and the main directions of state policy in the field of environmental protection, energy and resource conservation	Knows the regulatory framework and the main directions of state policy in the field of environmental protection, energy and resource conservation, with some shortcomings	Knows the regulatory framework and the main directions of state policy in the field of environmental protection, energy and resource conservation, with numerous errors and shortcomings	Does not know the legal framework and the main directions of state policy in the field of environmental protection, energy and resource conservation

		modern methods and means of environmental protection	Knows modern methods and tools for environmental protection without any flaws	Knows modern methods and means of environmental protection with some shortcomings	Knows modern methods and tools for environmental protection with numerous errors and shortcomings	Does not know modern methods and tools for protecting the environment
		economic aspects of environmental protection	Knows the economic aspects of environmental protection without any shortcomings	Knows the economic aspects of environmental protection with some shortcomings	Knows the economic aspects of environmental protection with numerous errors and shortcomings	Does not know the economic aspects of environmental protection
		Be able to				
		assess the potential danger of an object in terms of its impact on the environment;	He is able to assess the potential danger of an object in terms of its environmental impact without any flaws.	He is able to assess the potential danger of an object in terms of its environmental impact, with some minor drawbacks.	He is able to assess the potential danger of an object in terms of its environmental impact, with numerous errors and shortcomings.	Does not know how to assess the potential danger of an object in terms of its impact on the environment;

		select methods for cleaning industrial emissions, discharges, and waste recycling and disposal based on an analysis of scientific and technical	He is able to select methods for cleaning industrial emissions, discharges, and waste recycling and disposal based on an analysis of scientific and technical literature.	He is able to select methods for cleaning industrial emissions, discharges, and waste recycling and disposal based on an analysis of scientific and technical literature with certain shortcomings.	He is able to select methods for cleaning industrial emissions, discharges, and waste recycling and disposal based on an analysis of scientific and technical literature with numerous errors and shortcomings	Does not know how to select methods for cleaning industrial emissions, discharges, and waste recycling and disposal based on the analysis of scientific and technical literature
		make decisions taking into account the possible environmental impact of facilities and the requirements of energy and resource conservation	He is able to make decisions taking into account the possible environmental impact of facilities and the requirements of energy and resource conservation based on the existing regulatory framework without any	He is able to make decisions taking into account the possible environmental impact of facilities and the requirements for energy and resource conservation based on the existing regulatory framework, which has some shortcomings.	He is able to make decisions taking into account the possible environmental impact of facilities and the requirements for energy and resource conservation based on the existing regulatory framework, which contains numerous	He is unable to make decisions taking into account the possible environmental impact of facilities and the requirements of energy and resource conservation based on the existing regulatory framework.
		Own				

		skills in using environmental knowledge in everyday life and at work	Possesses the skills to use environmental knowledge in everyday life and at work without	Possesses skills in using environmental knowledge in everyday life and at work, with some shortcomings	Possesses skills in using environmental knowledge in everyday life and at work, with numerous errors and shortcomings	Does not have the skills to use environmental knowledge in everyday life and at work
		terminology in the field of environmental protection, rational nature management, energy and resource conservation	Proficient in environmental protection, sustainable development, energy and resource conservation	He is familiar with terminology in the field of environmental protection, rational nature management, and energy and resource conservation, but there are some shortcomings.	He knows the terminology in the field of environmental protection, rational nature management, and energy and resource conservation, but there are numerous errors and shortcomings.	Does not possess terminology in the field of environmental protection, rational nature management, energy and resource saving

		the main approaches to assessing environmental quality and the effectiveness of environmental measures.	Knows the basic approaches to assessing environmental quality and the effectiveness of environmental measures without any shortcomings	He is familiar with the basic approaches to assessing environmental quality and the effectiveness of environmental measures, with some shortcomings	He has a basic understanding of the approaches to assessing environmental quality and the effectiveness of environmental measures, but there are numerous errors and shortcomings.	Does not possess basic approaches to assessing environmental quality and the effectiveness of environmental measures
UC-8 Able to create and maintain safe living conditions in everyday life and professional activities to preserve the natural environment and ensure the sustainable development of society, including in the event of threats and emergencies and military conflicts	UC-8.1 Identifies potential threats to human life and health in everyday life and professional activities, creates and maintains safe conditions to ensure the sustainable development of society	To know				
		possible threats to human life and health, as well as methodological, regulatory, and guidance materials related to	Knows the possible threats to human life and health, as well as the methodological, regulatory, and guidance materials related to professional activities without any flaws	Knows the possible threats to human life and health, as well as the methodological, regulatory, and guidance materials related to professional activities with certain shortcomings	Knows the possible threats to human life and health, as well as the methodological, regulatory, and guidance materials related to professional activities with numerous errors and shortcomings	Does not know the possible threats to human life and health, as well as the methodological, regulatory, and guidance materials related to professional activities

		main characteristics of natural and man-made environments	Knows the basic characteristics of natural and technogenic environments without any flaws	Knows the basic characteristics of natural and technogenic environments with certain shortcomings	Knows the basic characteristics of natural and technogenic environments with numerous errors and shortcomings	Does not know the basic characteristics of natural and technogenic environments
		be able to				
		to develop methodological and regulatory materials, technical documentation, and to create and maintain safe conditio	He is able to develop methodological and regulatory materials, technical documentation, and create and maintain safe conditions for ensuring sustainable development of society	He is able to develop methodological and regulatory materials, technical documentation, and create and maintain safe conditions for ensuring sustainable development of society with certain shortcomings.	He is able to develop methodological and regulatory materials, technical documentation, and create and maintain safe conditions for ensuring sustainable development of society with numerous errors and shortcomings.	He is unable to develop methodological and regulatory materials, technical documentation, and create and maintain safe conditions for ensuring sustainable development of society.

		identify possible threats to human life and health in everyday life and in professional activities	He is able to identify possible threats to human life and health in everyday life and in professional activities without any mistakes.	He is able to identify possible threats to human life and health in everyday life and in professional activities with certain shortcomings.	He is able to identify possible threats to human life and health in everyday life and in professional activities with numerous errors and shortcomings	He is unable to identify possible threats to human life and health in everyday life and in his professional activities.
		own				

		methods of theoretical research related to the development and implementation of environmental protection and resource-saving measures, various types of new environmental protection equipment, environ	He/she is proficient in the methods of theoretical research related to the development and implementation of environmental protection and resource-saving measures, various types of new environmental protection equipment, environmentally friendly or low- and non-waste	He/she is familiar with the methods of theoretical research related to the development and implementation of environmental protection and resource-saving measures, various types of new environmental protection equipment, environmentally friendly or low-waste technological processes, and production facilities with certain shortcomings.	He is proficient in theoretical research methods related to the development and implementation of environmental protection and resource-saving measures, various types of new environmental protection equipment, environmentally friendly or low-waste technological processes, and production facilities with numerous errors and shortcomings.	Does not possess the methods of theoretical research related to the development and implementation of environmental protection and resource-saving measures, various types of new environmental protection equipment, environmentally friendly or low- and non-waste technological processes, production facilities, and production units

The **"excellent"** grade is awarded for completing the semester's calculation work, test assignments, demonstrating a deep understanding of environmental processes, and applying theoretical knowledge to solve environmental problems. The student must provide complete and meaningful answers to theoretical questions.

The **"good"** grade is awarded *for completing the semester's calculation work, test assignments, and demonstrating an understanding of the main theoretical and applied aspects of ecology, as well as the system of environmental processes. The student must provide answers to theoretical questions.*

The **"satisfactory"** grade is awarded *for completing the semester's calculation work and test assignments.*

A **"fail"** grade is given *for poor and incomplete completion of semester assignments and tests.*

3. List of assessment tools

Brief description of the assessment tools used in the current progress control and intermediate certification of the student in the discipline:

Name of the evaluation tool	Brief description of the evaluation tool	Description of the evaluation tool
Practical Assignment (PS)	A means of assessing the ability to apply theoretical knowledge in a practical situation. The task is aimed at assessing competencies in the discipline and contains clear instructions for execution or an algorithm of actions	Set of tasks and assignments
Test (Test)	A system of standardized tasks that allows you to automate the process of measuring a student's knowledge and skills	A set of test tasks

4. A list of control tasks or other materials necessary for assessing the knowledge, skills, and abilities that characterize the stages of competency development during the course of the discipline

Example of a task

For the current TC1 control:

Competence being tested: UK-2.2

Test

1. "A set of components of the natural environment, natural and natural-anthropogenic objects, as well as anthropogenic objects" is the definition of:

a) natural environment;

b) environment;

c) natural and anthropogenic object;

d) natural ecological system.

2. from the standpoint of existing legislation, harm to the environment causes negative consequences:

a) economic;

b) cultural;

c) social;

d) environmental.

3. The ozone layer is:

a) an independent object of environmental protection;

b) is considered as a component of airspace

4. A specially protected natural area in which all forms of economic activity are completely excluded is called:

a) reserve;

b) reserve;

c) national park;

d) a natural monument.

5. For which type of water use the most stringent MPC standards are established:

a) household and drinking;

b) public utilities;
c) fishery.

Questions to the complex task TK1

1. The subject, goals and objectives of industrial ecology.
2. the problem of the destruction of the Earth's ozone layer.
3. Pollution of water bodies with heavy metals. Effects of pollution.
4. greenhouse effect. Causes of greenhouse effect formation.
5. The problem of anthropogenic pollution of the hydrosphere.

Typical tasks:
Example of a practical task

Calculate the continuous settling tank for precipitation of solid particles of the aqueous suspension. Diameter of the smallest particles to be deposited, dh, μm. Sump capacity by suspension, Gc, kg/h. Suspension concentration xc. Particle density ρ h, kg/m^3. Suspension temperature t, ^{0}C. Sediment humidity U.

Determine the clarifying liquid sump capacity $G_{осв}$, solid phase capacity $G_{т.ф}$, settling area Foc, sump diameter D, total sump height H, volumetric capacity $V_{осв}$. Provide a diagram of the continuous sump and a description of its principle of operation.

For TK2 monitoring:

Competence to be checked: UK-2.2; UK-8.1

Test

1. Environmental legislation of the Russian Federation provides for environmental
expertise:
a) state;
b) departmental;
c) scientific;
d) public;
e) commercial.
2. In the Russian Federation, environmental certification is carried out in:
a) voluntary form;
b) mandatory form;
c) in voluntary and mandatory forms.
3. The objects of environmental certification are:
a) pre-planned documents;
b) new equipment;
c) design documentation.
d) materials;
e) substances.
4. Environmental control functions are:

a) preventive;
b) social;
c) informational;
d) punitive;
e) investment;
f) cultural and educational.

Questions to the complex task TK2

1. Energy. Linking environmental concerns to rising energy consumption.
2. Contamination of soils with production waste and consumption waste.
3. Hygienic normalization of environmental quality indicators. MPC, MPE, PDS, MPP.
4. Wastewater treatment methods.
5. Environmental crisis. Reasons, exit routes.

Typical tasks:

1. Using the above methodology, calculate the required efficiency of wastewater treatment from pollutants (presented in Table 1) discharged by the enterprise into water bodies, taking into account its purpose. 2. Based on the calculations made for each substance, propose a treatment facility from those presented in Table 2, or a combination of them that provide the required degree of treatment.

2. Using the above methodology, calculate the hazard category of the enterprise depending on the mass and nomenclature of pollutants emitted into the atmosphere. The company has 19 sources of emissions of pollutants into the atmosphere, the names of which are given in the table. Calculate the hazard category of the enterprise.

For TK3 monitoring:

Competence to be checked: UK-2.2; UK-8.1

Test

1. What is the principle of environmental safety?

a). Liability for substantial damage to environmental systems beyond national jurisdiction or control;

b). The obligation of States to take all necessary measures to effectively prohibit the use of means of adverse environmental impact;

c). Taking all necessary measures to protect the marine environment from pollution;

d). the prohibition of acts of States within their jurisdiction or control prejudicial to the ecological systems of foreign States;

e). Reflects the global and extremely acute nature of international environmental issues.

2. By what criterion are local, regional and global environmental monitoring distinguished?

a) assessment of the actual state of the environment

b) factors of anthropogenic impact

c) territorial coverage

d) ecological reserves of the biosphere

3. What parameters are considered when justifying and assessing the impact on the hydrosphere:

a) assessment of changes in surface runoff (liquid and solid) as a result of redevelopment of the territory and removal of the vegetation layer, identification of negative consequences of these changes on the water regime of the territory;

b) measures to ensure fire safety of forests and other plant communities;

c) assessment of damage caused to vegetation due to disturbance and pollution of the environment (air, water, soils), felling of forest vegetation and redevelopment of territories?

Questions to the complex task TK2

1. environmental monitoring.

2. environmental impact assessment. Environmental certification.

3. environmental control.

4. environmental passport of an industrial enterprise.

5. The main directions of development of low-waste and waste-free industries.

Typical tasks:

1. Using the above methodology, estimate the period of depletion of the natural resource if the level of resource production in the current year is known, and resource consumption in subsequent years will increase at a given rate of increase in annual consumption. Initial data for performance of work are given in Table.

Calculate the depletion time of the resources shown in the table, insert the data as an additional row into the table. Make a conclusion about the sequence of termination of resource extraction.

2. 1).Based on the given data of the task, draw up a closed cycle version of the production enterprise. Outline the basic definitions and concepts. 2). Explore the Enterprise Closed Loop Example 3). Draw up your own version of the closed cycle scheme of the enterprise. Methods used: visual (graphic representation of the closed cycle scheme of the enterprise), practical - performing the task of practical work.

For intermediate qualification:

1. Environmental pollution. Types of environmental pollution environments.

2. Environmental impact assessment.

3. The concept of MPC of a harmful substance in the air.
4. Classification of industrial wastewater
5. Modern global environmental problems.
6. Basic methods for cleaning air pollutant emissions.
7. Land reclamation.
8. Industrial ecology as a branch of ecology. Basic concepts in accordance with the Federal Law "On Environmental Protection."
9. Basic methods for cleaning air pollutant emissions.
10. Peculiarities of environmental pollution by enterprises of various industries (farms).
11. Scientific basis for rationing the content of pollutants in atmospheric air.
12. Environmental audit.
13. MPC of pollutants and their classification.
14. Pollution of water bodies, composition and properties of wastewater.
15. Soil pollution. Reclamation of contaminated land.
16. Consequences of air pollution.
17. Classification of water bodies. Types and categories of water use.
18. Air pollution and methods of cleaning emissions from pollutants.
19. Ecological expertise.
20. Environmental monitoring.
21. Environmental passport of an industrial enterprise.
22. Environmental control.
23. Environmental accounting and reporting.