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**Federal State Autonomous Educational Institution for Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA (RUDN University)
named after Patrice Lumumba
Institute of Environmental Engineering**

COURSE SYLLABUS

**MSW Recycling and Utilization Technics / Технологии рециклинга и
утилизации ТКО**

**Recommended by the Didactic Council for the Education Field for the
specialization:**

05.04.06 "Ecology and nature management"

**The mastering of the course is carried out as part of the implementation of the
main professional syllabus (Higher Education program, specialization)**

Integrated Solid Waste Management / Комплексное управление твердыми бытовыми
отходами

1. COURSE GOAL(s)

The discipline is aimed at studying the sources of waste formation and its composition, the main types of waste, their brief characteristics, principles of classification and subsequent processing, methods of mechanical processing and sorting, thermal recycling, including direct (layered) combustion, different types of pyrolysis, gasification, features combustion of solid and liquid combustible waste. Separately, methods of processing and disposal of sewage sludge are considered, depending on humidity, density, fluidity and contamination, as well as sludge preparation processes: compaction, stabilization, conditioning, dewatering, disinfection and neutralization.

Objectives of the discipline - formation:

- knowledge in the field of technological solutions used for processing and disposal of solid waste.

- the ability to correctly classify waste, select methods of processing, sorting and disposal

- knowledge of techniques for drawing up technological schemes for the preparation and disposal of waste of different hazard classes, choosing the best available waste disposal technology, calculating the costs of implementing the technology

The purpose of mastering the discipline is to develop knowledge, skills and abilities in the field of processing and disposal of hazardous and municipal waste, and study technological equipment.

2. REQUIREMENTS FOR COURSE OUTCOMES

Mastering the discipline “MSW Recycling and Utilization Technics / Технологии рециклинга и утилизации ТКО” is aimed at developing in students the following competencies (part of competencies):

Code	Code and name of the graduate's competence	Code and name of the indicator of achievement of competence
GPC -1	Able to use philosophical concepts and methodology of scientific knowledge when studying various levels of organization of matter, space and time	GPC-1.1 Knows the relationship between the intuitive, unconscious and conscious in scientific creativity, the social and psychological motives of scientific creativity; problems of moral assessment of scientific creativity; bioethics; integrative trends of modern knowledge;
		GPC-1.2 Provides methodological substantiation of scientific research
		GPC-1.4 Possesses the skills of historical and methodological analysis of scientific research and its results; all types of scientific communication; techniques for conducting discussion and polemics, skills in public speaking and written, reasoned presentation of one's own point of view;
GPC-2	Able to use special and new sections of ecology, geocology and environmental management	GPC-2.1 Has a systematic understanding of the theoretical and methodological foundations of environmental regulation;

	when solving scientific problems research and applied tasks of professional activity	<p>GPC-2.2 Masters modern methods of obtaining and assessing geochemical information to solve theoretical and practical problems of environmental geochemistry in the field of ecology and environmental management for the purpose of environmental protection</p> <p>GPC-2.3 Knows basic knowledge of fundamental sections of biology to the extent necessary to master the fundamentals of ecology and environmental management;</p> <p>GPK-2.4 Analyzes the current system of environmental regulation for various areas of environmental management;</p> <p>GPC-2.5 Identifies and describes biological diversity, evaluates it using modern methods of quantitative information processing;</p>
PC -2	the ability to creatively use knowledge of fundamental and applied sections of special disciplines of the master's program in scientific, production and technological activities	<p>PC-2.1 Able to study the natural, man-made, socio-economic, demographic and medical-biological situation, search for cultural heritage sites in the study area;</p> <p>PC-2.2 Able to predict possible adverse changes in the natural and man-made environment, conduct a preliminary analysis of the consequences of the information obtained during research;</p> <p>PC-2.3 Possesses the skills to perform research on environmental objects based on chemical, microbiological, parasitological, toxicological indicators;</p> <p>PC-2.4 Able to collect and analyze environmental information about the natural and man-made environment, physical geographic and climatic conditions based on materials from previous years' work;</p>

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

Know: the principles of the hierarchy of production and consumption waste management, the theoretical foundations for constructing territorial schemes for waste management using modern methods of analysis and international approaches, the main parameters of waste used in the classification, choice of processing method and in drawing up a territorial scheme.

know how to use: FKKO catalog, analyze the available data on the morphological, chemical, fractional and energy composition of waste, decipher the territorial schemes and draw up your own options, analyze and optimize the work of the regional operator, calculate the amount of the environmental fee for nature users (manufacturers and importers of goods and services)

Possess: the skills of determining the hazard class and classification of waste, working with regional programs in the field of waste management, choosing the best available waste processing technology.

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

Discipline refers to the **the variable part of block 1** of the curriculum.

Table No. 1 shows the previous and subsequent disciplines aimed at the formation of the competencies of the discipline in accordance with the competency matrix of the EP HE in accordance with the educational standard of the RUDN University in the direction 05.04.06 "Ecology and nature management"

Table

No. 1 Previous and subsequent disciplines aimed at the formation of competencies

No. p/p	Code and name of competence	Previous disciplines	Subsequent disciplines (groups of disciplines)
GPC -1	Able to use philosophical concepts and methodology of scientific knowledge when studying various levels of organization of matter, space and time	Methodology of Scientific Creation; Research Work; Производственная;	Pre-graduation Practical Training;
GPC-2	Able to use special and new sections of ecology, geoecology and environmental management when solving scientific problems research and applied tasks of professional activity	Modern technologies for nature protection; Regional & Municipal MSW Management Systems; Environmental Impact Assessment (EIA) of SWM objects; <i>Basics of Circular Economics**</i> ; <i>Green Economy and Tools for Enterprises Sustainable Development**</i> ; Research Work; Производственная;	Pre-graduation Practical Training;
PC -2	the ability to creatively use knowledge of fundamental and applied sections of special disciplines of the master's program in scientific, production and technological activities	Methodology of Scientific Creation; Research Work; Производственная;	Pre-graduation Practical Training;

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the discipline is **3** credit units.

Table 4.1. Types of educational work by periods of mastering EP VO for **full-time** education

Types of academic activities	Total hours	Semester(s)			
		1	2	3	4
Contact academic hours					
Lectures	17			17	
Lab works					
Seminars (workshops/tutorials)	34			34	

<i>Self-study</i>		66			66	
<i>Evaluation and assessment (exam; pass/fail grading)</i>		27			27	
Total course workload	hours	144			144	
	credits	4			4	

5. COURSE CONTENT

Table 5.1. The content of the discipline (module) by type of educational work

Name of the discipline section	Contents of the section (topic)	Type of study*
1. INTRODUCTION: WASTE MANAGEMENT ISSUES AND SOLUTIONS	1Topic 1.1. Sources of waste generation and impact on the environment. Modern approaches to waste management. Waste in circular economy. Concepts and basic principles of resource saving. Products from Waste: Problems and Solutions. Waste processing industry. materials. Technology for the production of secondary raw materials.	L, S
	Topic 1.2. Technologies for municipal solid waste processing. General characteristics of technologies. The main types of waste, their brief description, principles of classification and subsequent processing. Basic concepts of waste management. Warehousing and landfilling of MSW.	
Section 2 NON-ORGANIC WASTE: PROCESSING.	Topic 2.1. Mechanical processing of solid waste. Methods for the preparation and processing of solid waste. Goals of waste processing. Waste shredding: crushing and grinding, milling. Crushing stages, basic regularities. Large medium and fine crushing. Grinding of hard materials. Fine and ultra-fine grinding. Grinding schemes. Mill types. Classification of materials and equipment for its implementation.	L, S
	Topic 2.2 Separation technics and equipment. Principles of classification. Hydraulic and air classification and equipment for implementation. Aeroseparation. Vibroseparation. Hydroseparation. Dosing of bulk materials. Feeders. Dosers. Mixing solids. Screening. Types of screens, grids and sieves	
Section 3 ORGANIC WASTE: HANDLING.	Topic 3.1. Thermal processing of waste. Obtaining granulated fuel (RDF). Waste pyrolysis. Oxidative pyrolysis followed by combustion of pyrolysis gases; dry pyrolysis. Waste gasification. Fire method of waste processing. Incineration of solid combustible waste. Classification of combustion methods. Equipment for fire neutralization and waste processing.	L, S
	Topic 3.2 Microbiological decomposition of bioorganic waste. Composting (stages, technics and equipment, parameters, products). Methane digestion (stages, conditions, products). compaction, stabilization, conditioning, dewatering, decontamination and decontamination	L, S

	Topic 3.3. Sewage sludge. Formation of sewage sludge. Characteristics of sediments (humidity, density, fluidity and contamination. Sludge Treatment Processes: Compaction, Stabilization, Conditioning, Dewatering, Decontamination and Neutralization.	
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6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom equipment and technology support requirements

Audience type	Audience equipment	Specialized educational / laboratory equipment, software and materials for mastering the discipline (if necessary)
Lecture	An auditorium for lecture-type classes, equipped with a set of specialized furniture; board (screen) and technical means of multimedia presentations.	A set of specialized furniture; chalk board; hardware: HP PRO system unit, HP-V2072A monitor, LUMIEN retractable projection screen, Internet access. Microsoft Windows 7 corporate. License No. 5190227, date of issue March 16, 2010 MS Office 2007 Prof, License No. 6842818, date of issue 09/07/2009
Seminar	An auditorium for conducting seminar-type classes, group and individual consultations, current control and intermediate certification, equipped with a set of specialized furniture and technical means for multimedia presentations.	
computer class	Computer class for conducting classes, group and individual consultations, current control and intermediate certification, equipped with personal computers (in the amount of ___ pcs), a board (screen) and technical means of multimedia presentations.	
For independent work of students	An auditorium for independent work of students (can be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to the EIOS.	

7. RECOMMENDED SOURCES FOR COURSE STUDIES

Main reading:

1. Kharlamova M.D. Kurbatova A.I. Modern Technologies of Waste Management, Recycling and Environmental Protection / Современные методы обращения с отходами, рециклинг и защита окружающей среды - М. : Изд-во РУДН, 2017. - 98 с. : ил.
2. L.G. Canin A.V. Engineering ecology: protection of the lithosphere from solid industrial and household waste. Tutorial. М., INFRA-M. 2018, -556 p.

Additional reading

- G. Canin A.V. Engineering ecology: processes and apparatus for wastewater treatment and sediment processing: textbook. allowance. – M.: INFRA-M, 2017. – 605 p. +Additional materials
- Applied ecobiotechnology: textbook in 2 volumes, v.2./A.E. Kuznetsov, N.B. Gradova, S.V. Lushnikov and others. -M.: BINOM, Knowledge Laboratory, 2020.- 485 p.: ill

Internet-based sources

1. **I-iversity** platform (Springer Nature): course “Practical Tools of Solid Waste Management and Environmental Damage Reducing” by Kharlamova M.D. (RUDN UNIVERSITY). URL: <https://iversity.org/en/courses/practical-tools-of-solid-waste-managementenvironmental-damage-reducing>
2. **Coursera** platform: course “Municipal Solid Waste Management in Developing Countries” URL: <https://www.coursera.org/learn/solid-waste-management?>
3. ELS of RUDN University and third-party ELS, to which university students have access on the basis of concluded agreements:
 - RUDN Electronic Library System - RUDN EBS <http://lib.rudn.ru/MegaPro/Web>
 - ELS "University Library Online" <http://www.biblioclub.ru>
 - EBS Yurayt <http://www.biblio-online.ru>
 - ELS "Student Consultant" www.studentlibrary.ru
 - EBS "Lan" <http://e.lanbook.com/>
 - EBS "Trinity Bridge"
4. Databases and search engines:
 - electronic fund of legal and normative-technical documentation <http://docs.cntd.ru/>
 - Yandex search engine <https://www.yandex.ru/>
 - Google search engine <https://www.google.ru/>
 - abstract database SCOPUS <http://www.elsevier.com/locate/scopus/>

9. MID-TERM ASSESSMENT AND EVALUATION TOOLKIT

Evaluation materials and a point-rating system* for assessing the level of competencies (parts of competencies) based on the results of mastering the discipline Regional & Municipal MSW Management Systems are presented in the Appendix to this Work Program of the discipline.

DEVELOPER:

Associate Professor of the
ES&PQM Department

Kharlamova M.D.

Position

Signature

Name, Surname

HEAD OF DEPARTMENT:

Director of ES&PQM Department

Savenkova E.V.

Position

Signature

Name, Surname

HEAD OF PROGRAMME:

Associate Professor of the
EM Department

Kapralova D.O.

Position

Signature

Name, Surname

signature (Savenkova E.V.)

ASSESSMENT TOOLKIT

for the course

MSW Recycling and Utilization Technics
course title

05.04.06 "Ecology and nature management"
field of studies / speciality code and title

«Integrated Solid Waste Management
higher education programme profile/specialisation title

Master
graduate's qualification (degree)

Passport to Assessment Toolkit for Course MSW Recycling and Utilization Technics

Field of Studies / Speciality 05.04.06 "Ecology and nature management"/ «Integrated Solid Waste Management»
code title

Course: **MSW Recycling and Utilization Technics**

Competences (competences in part) under assessment	Course module under assessment	Course topic under assessment	Tools to assess higher education programme mastering level									Points for topic	Points for module
			Class work					Self-studies			Exam/Pass-fail assessment		
			Quiz	Test	Work with lecture materials	Work at the seminars	Lab work	Homework	Research essay/ Library research paper	Calculation and graphic work			
GC-1.1; GC-1.2; GC-1.3	Section 1 INTRODUCTION: WASTE MANAGEMENT ISSUES AND SOLUTIONS	Topic 1.1. Sources of waste generation and impact on the environment. Modern approaches to waste management. Waste in circular economy. Concepts and basic principles of resource saving. Products from Waste: Problems and Solutions. Waste processing		3	1	2		2				8	16

		industry. Secondary raw materials. Technology for the production of secondary raw materials.												
GPC-2.1-2,5		Topic 1.2. Technologies for municipal solid waste processing. General characteristics of technologies. The main types of waste, their brief description, principles of classification and subsequent processing. Basic concepts of waste management. Warehousing and landfilling of MSW.		3	1	2		2					8	

GC-2.1-2.4	Section 2 NON-ORGANIC WASTE: PROCESSING.	Topic 2.1. Mechanical processing of solid waste. Methods for the preparation and processing of solid waste. Goals of waste processing. Waste shredding: crushing and grinding, milling. Crushing stages, basic regularities. Large medium and fine crushing. Grinding of hard materials. Fine and ultra-fine grinding. Grinding schemes. Mill types. Classification of materials and equipment for its implementation.		3	1	2		2					8	16
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GC-2.1-2.4		Topic 2.2 Separation technics and equipment. Principles of classification. Hydraulic and air classification and equipment for implementation. Aeroseparation. Vibroseparation. Hydroseparation. Dosing of bulk materials. Feeders. Dosers. Mixing solids. Screening. Types of screens, grids and sieves		3	1	2		2					8	
GC-2.1-2.4	Section 3 ORGANIC WASTE: HANDLING.	Topic 3.1. Thermal processing of waste. Obtaining granulated fuel (RDF). Waste pyrolysis. Oxidative pyrolysis followed by combustion of pyrolysis gases; dry pyrolysis. Waste gasification. Fire method of waste processing. Incineration of solid combustible waste. Classification of combustion methods. Equipment for fire neutralization and waste processing.		3	1	2		2					8	24
GC-2.1-2.4		Topic 3.2 Microbiological decomposition of bioorganic waste. Composting (stages, technics and equipment, parameters, products).		3	1	2		2					8	

	Methane digestion (stages, conditions, products).												
GC-2.1-2.4	Topic 3.3. Sewage sludge. Formation of sewage sludge. Characteristics of sediments (humidity, density, fluidity and contamination. Sludge Treatment Processes: Compaction, Stabilization, Conditioning, Dewatering, Decontamination and Neutralization.		3	1	2		2					8	
	TOTAL		21	7	14		14			30	14	56	56

QUESTION CARD No 1

QUESTION 1 Organic matter in the Environment. Biogeochemical cycles of nitrogen and phosphorous. Processes of methane digestion: stages and bacterial groups.

QUESTION 2 The main types of waste, their brief characteristics, the principles of classification and processing

Developer _____ (Kharlamova M.D.)
signature

Head of Educational Department _____ (Savenkova E.V.)
signature

day, month, year

Note * Practice case/task inclusion is subject to the teacher's discretion.

The set of exam question cards is complemented by the assessment criteria developed by the teacher and approved at the department meeting.

EXAMPLES OF TESTS

1. The information system for maintaining the Waste Cadastre includes the following main blocks:
 - a. databank on the presence of restrictions on the location of the waste management facility
 - b. catalog data bank
 - c. databank of GIS technologies and cartographic materials
 - d. vehicle data bank
 - e. investor data bank
 - f. databank of waste and technologies for their processing
 - g. state register of waste disposal facilities
2. To determine the resource characteristics of waste, it is necessary to take into account (add the missing physical and chemical parameters):
 - a. waste composition (name and formula of the substance)
 - b. hazardous properties of waste
 - c. technological processes in which it is possible to use waste
 - d.
 - e.
 - f.
3. Wastes that can be used as SMR and VER are formed mainly at the following stages of the product (item) life cycle:
 - a. product development
 - b. production of products
 - c. product sales
 - d. product operation
 - e. product repair
 - f. waste disposal

4. The main tasks of waste management in accordance with the waste management hierarchy are (put in the required order)
 - a. minimization of costs for sanitary cleaning of the city;
 - b. selection of environmentally friendly waste processing methods with the lowest economic costs;
 - c. the maximum possible involvement of waste in the economic circulation and their material and energy utilization as technogenic raw materials;
 - d. minimization of the amount of generated waste;
 - e. gradual transition from landfill disposal of solid waste to industrial processing.
5. Obligatory processes providing a comprehensive scheme for MSW processing are:
 - a. separate collection
 - b. organization of transportation without increasing the shoulder of removal
 - c. organization of transportation from equidistant objects
 - d. mechanical separation
 - e. mechanical grinding
 - f. biothermal processing (composting, anaerobic digestion)
 - g. thermal processing

Assessment criteria:

(in compliance with the legal regulations in force)

The assessment of all the results of the development of competencies is carried out in accordance with the scale of the international point-rating system ECTS. In accordance with the calculated grading system (* see the passport of the FOS), the student gains the necessary points.

Work in class (for one hour of class): max 1 point. The mark is given for the presence and active work at a seminar or at a lecture (lectures are held in an interactive form) - answers to current questions, notes, discussion.

Self-preparation for the lesson: max 3 points for each topic. The topic is prepared, there is a presentation, calculation results, the student freely answers the questions - 2 points; the student is present at the lesson, participates in the discussion, but finds it difficult to answer the questions - 1 point. The student is absent or the assignment is not prepared - 0 points

Midterm and final certification:

The assessment is made as a percentage of the total number of checked tasks, with the subsequent conversion of percentages into points in accordance with the approved BRS. For example, a student answered correctly 10 out of 15 test questions, therefore, he scored 67%. The maximum score for the midterm certification is 9, multiplying 0.67 by 9, we get 6 points. This point is set in the general statement and is added to the rest of the points. A student is considered to have successfully passed the midterm or final certification if the sum of points for all types of activities at the time of certification exceeds 50% of the maximum possible score.

The final grade for the semester is the sum of the points for all the student's activities (* see the passport of the FOS) and can reach a maximum of 86 points, that is, the lower limit of the grade "excellent", category B.

The final exam is surrendered by the student voluntarily, if he scored the minimum possible score for certification - **51 points**. In other cases, the exam is mandatory and is estimated at a maximum of **14 points**, as a result, the total score is derived taking into account the result of passing the exam and the final grade corresponds to the international ECTS scale. If a student scores less than **7 points** on the exam, then the exam is considered not passed and the student can take it again (reexam).

QUESTIONS FOR SELF-TRAINING

1. Waste management strategy in the focus of sustainable development. Current position indicators
2. Procedure for waste components identifying
3. Quantitative and qualitative composition of MSW. Factors affecting waste generation. Composition of municipal MSW.
4. Production control in the field of waste management
5. Basic principles of strategic waste management, waste management hierarchy. Waste program, implementation levels.
6. Determination of the waste hazard class. Calculated and empirical methods.
7. Complex schemes for MSW processing. Mandatory components. Stages of implementation.
8. Production control of waste components. Control methods. Integral and specific indicators.
9. Experience of waste management in developed countries: experience and comparison of management methods.
10. Catalogs and registries of waste. Waste code information
11. Hazardous municipal waste: list, organization of separate collection, disposal methods. Russian and foreign experience.
12. Requirements for the development of draft waste generation standards.
13. Peculiarities of rationing for thermal waste processing. Environmental aspects of direct waste incineration. Alternative thermal processing methods.
14. Resource characteristics of waste. Recycling technologies.
15. State cadaster of waste. Appointment, main blocks.
16. Polygon burial. Environmental aspects and requirements for the organization of sanitary landfills for waste disposal.
17. Legislation of Russia in the field of waste management. Goals, objectives and methods of implementation.
18. Product life cycle and waste generation. Waste as a source of secondary resources and energy
20. Methods of economic incentives for the collection and recycling of waste.
21. Territorial scheme of production and consumption waste management. 22. Extended Producer Responsibility Institute. Environmental fee
23. Regional operator - functions, rights and obligations.
24. Assessment and selection of technologies for rational sorting of solid waste (preparation for complex processing).
25. Modern technologies for neutralization and utilization of the organic fraction of waste.
26. Approaches and types of waste classification.
27. Thermal methods of solid waste disposal. Environmental and economic aspects of thermal processing
28. Federal classification catalog of waste. Purpose, principles of compilation, code structure.
29. Integrated schemes for sorting and recycling MSW. Principles and approaches.
30. Certification of hazardous waste as a tool for effective management
31. Material balances at the enterprise. Accounting for waste generation at all stages of production.

Tentative list of assessment tools

п / п	Assessment tool	Brief features	Assessment tool representation in the kit
<i>Class work</i>			

1	Survey/Quiz	A tool of control, organised as a special conversation between a teacher and students on topics related to the course under study, and designed to clarify the amount of students' knowledge in a particular section, topic, problem, etc.	Questions on the course topics /modules
2	Test	A system of standardised tasks that allows the teacher to automate the procedure for measuring the student's level of knowledge and skills	Tests bank
3.	Colloquium	A tool for monitoring the acquisition and mastering of educational material on a topic, section or sections of a discipline, organised as a training session in the form of an interview among the teacher and students.	Questions on the course topics /modules
4	Control work	A tool of control organised as a classroom lesson, at which students need to independently demonstrate the acquisition and mastering of the educational material of the course topic, section, or sections.	Questions on the course topics /modules
5	Lab work	The system of practice tasks aimed at the students' practical skills formation	Practice tasks bank
6.	Round table, discussion, polemic, dispute, debate, (class work)	Evaluation tools that allow the teacher to engage students in the process of discussing controversial issues, problems and assess their ability to argue their own point of view.	List of themes for round tables, discussions, polemics, disputes, debates.
7	Business game and/or role play	Joint activities of a student group under the teacher's control to solve educational and professionally oriented tasks through the simulation of a real-world problem; this activity allows the teacher to assess the students' ability to analyse and solve typical professional challenges.	Topic (problem), concept, roles and expected results for each game
8.	Essay	A tool that allows the teacher to assess the student's ability to express in writing the essence of the under study, to independently analyse this issue using the concepts and analytical tools of the relevant discipline, to draw conclusions that summarise his/her position on the issue under consideration.	Themes for essays
9.	Presentation (defence) of	A tool for monitoring the students' ability to present the work results to the audience.	Themes for projects/reports/
	project/report/ Library research paper /briefs *		Library research paper/ briefs

10	Pass/Fail assessment	A tool for checking the quality of students' performance of laboratory work, acquisition and mastering of the practice training and seminar educational material, successful completion of the advanced field internship and pre-graduate internship and fulfillment of all training assignments in the course of these internships in accordance with the approved programme.	Tasks examples
11	Exam	The evaluation of the student's work during the semester (year, the entire period of study, etc.); it is designed to identify the level, soundness and systematic nature of theoretical and practical knowledge gained by the student, formation of independent work skills, development of creative thinking, ability to synthesise the acquired knowledge and apply it to solve practice tasks.	Examples of tasks/questions/exam question cards
12	Internship and research and development (R&D) report	A form of written work that allows the student to generalise his/her knowledge, skills and abilities acquired during the introductory and advanced field internships, scientific and industrial internships and R&D activities.	
13	Case	A problem-solving task in which the student is asked to comprehend the real work-related (occupational) situation necessary to solve the problem.	Assignments to solve the case
14	Multi-level tasks and assignments with varying difficulty	The tasks and assignments differ in terms of the following levels: a) reproductive level allows the teacher to evaluate and diagnose the students' knowledge of factual material (basic concepts, algorithms, facts) and the students' ability to correctly use special terms and concepts, recognize objects of study within a certain section of the discipline, b) reconstructive level allows the teacher to evaluate and diagnose the students' abilities to synthesise, analyse, generalise factual and theoretical material and formulate specific conclusions, establish cause-and-effect relationships, c) creative level allows to evaluate and diagnose students' skills to integrate	Set of multi-level tasks and assignments with varying difficulty

		knowledge of various fields, argue their own point of view.	
<i>Self- studies</i>			

1	Calculation and graphic work	A tool for checking students' skills in applying the acquired knowledge according to a predetermined methodology in task solving or fulfilling assignments for a module or discipline as a whole.	Set of tasks for calculation and graphic work
2	Course work/project	A type of independent written work aimed at the creative development of general professional and specialised professional disciplines (modules) and the development of relevant professional competences	Course assignment themes
3	Project	The final "product" that results from planning and performance of educational and research tasks set; it allows the teacher to assess the students' ability to independently shape their knowledge in the course of solving practice tasks and problems, navigate in the information environment and the students' level of analytical, research skills, skills of practical and creative thinking; it can be implemented individually or by a group of students.	Themes for teambased or individual projects
4	Research essay (Library research paper)	The student's independent work in writing that summarises the results of the theoretical analysis of a certain scientific (educational and research) topic, where the author reveals the essence of the problem under study, considers different points of view, as well as argues his/her views on the material under consideration.	Themes for research essay (library research papers)
5	Reports, briefs	The product of the student's independent work, which is a public performance on the presentation of the results of solving a specific educational, practical, research or scientific topic.	Themes for reports, briefs
6	Essay and other creative assignments	A partially regulated assignment that has a non-standard solution and allows the teacher to diagnose students' skills in integrating knowledge from various fields and arguing their own point of view; it can be prepared individually or by a group of students.	Themes for teambased or individual creative assignments
7	Standard calculations	A tool to test skills in applying the acquired knowledge, according to a predetermined methodology, solving tasks or fulfilling assignments for a module or discipline as a whole.	Set of tasks for standard calculations
8	Homework	The tasks and assignments differ in terms of the following levels:	Set of multi-level tasks and

	<p>a) reproductive level allows the teacher to evaluate and diagnose the students' knowledge of factual material (basic concepts, algorithms, facts) and the students' ability to correctly use special terms and concepts, recognize objects of study within a certain section of the discipline,</p> <p>b) reconstructive level allows the teacher to evaluate and diagnose the students' abilities to synthesise, analyse, generalise factual and theoretical material and formulate specific conclusions, establish cause-and-effect relationships,</p> <p>c) creative level allows the teacher to evaluate and diagnose students' skills to integrate knowledge of various fields, argue their own point of view.</p>	<p>assignments with varying difficulty</p>
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Methodical instructions for students on mastering the discipline

Midterm certification is carried out in the form of testing according to the course passed. In the middle and at the end of the semester, final testing is carried out, the number of points is written in the BRS. Passing the exam (final scores) is included in the total score based on a maximum of 100 points.

Project work is carried out during the semester by groups of students, the number of students in a group depends on the number of stages in the project. Self-preparation for the seminar includes the collection of the necessary material and is prepared in accordance with the stage of the general assignment using Internet resources and evidence provided by the teacher. The defense of the project work is carried out in stages at each lesson, in the presence of all students of the study group. An electronic presentation must be prepared for the defense, illustrating the results obtained. The report should be carried out orally, the student should be fluent in the prepared material and answer the questions of the teacher and other students. At each stage, the student is responsible for the preparation of the stage, so by the end of the semester each student in the group goes through his own stage of defense.

The final assessment of the project work is carried out by summing the points received in the semester by groups.

Department Environmental Safety and Product Quality Management

educational department to be specified

Themes for team-based or individual creative assignments/projects**

for the course MSW Recycling and Utilization Technics

course title

TASK FOR PROJECTS

Seminar assignments are carried out in the form of collective research projects. Project work is carried out during the entire module by teams of students, the number of students in the team is 4-5 people (depends on the number of students in the study group). The goal of teamwork is to develop and defend a training project for the selected research region. As a region, each team chooses a

municipal district, city or regional district with various types of predominant nature management - agricultural, industrial, recreational, etc.

The **first practical lesson** (case) is analytical in nature and allows students to get acquainted with the world experience in the management of Municipal Solid Waste. Each research team is given a task for a specific region of the world - Germany, Sweden, Finland, Norway, Japan. Students should identify the main ideas, goals and objectives that the waste management program in the studied region fulfills. Determine the advantages and weaknesses of the program, make a conclusion about the advisability of using international experience.

In the **second lesson**, each team chooses a study region in Russia or abroad, analyzes the existing waste management program, the current ecological situation in the region, determines priority types of nature management, environmental problems of the region, including the presence of waste dumps, analyzes the negative impact on environmental components (indicating reasons of impact, specific impact zones, water bodies, natural areas, residential and agricultural areas, human health etc.).

In the **third lesson**, the teams analyze the main waste streams generated in the region, the composition of MSW (morphological, fractional, energy), identify those fractions for which it is advisable to recycle. The teams analyze the prospects and possibilities of closing the landfill, the presence of waste disposal facilities in the area (sorting stations, heat treatment plants). For the selected priority waste fractions, it is necessary to determine the optimal processing and disposal technologies.

In the **fourth lesson**, the teams determine the priority waste streams in the study area: these can be either the most significant streams in terms of generation, or the most problematic ones - causing environmental problems in the region. For example, in an industrial region it can be waste from the metallurgical industry (slags), in an agricultural region - stocks of unused pesticides or mineral fertilizers. Depending on the selected priority type of waste, the team proposes a method for their disposal, taking into account the criteria for choosing the best available technology.

|Developer
signature

_____ (Kharlamova M.)

day, month, year |

Assessment criteria:

(in compliance with the legal regulations in force)

Self-preparation for seminars includes collecting the necessary material using Internet resources and evidence. The defense of the project work is carried out in stages at each lesson, in the presence of all students of the study group. An electronic presentation must be prepared for the defense, illustrating the results obtained. The report should be carried out orally, the student should be fluent in the prepared material and answer the questions of the teacher and other students. At each stage, the student is responsible for the preparation of the stage, thus, by the end of the semester, each student in the group goes through his own stage of defense. Team members have the right to help the speaker if he finds it difficult to answer questions.

The final assessment of the project work is carried out by summing the points obtained in the semester by groups.

DEVELOPER:

Associate Professor of the
ES&PQM Department

Kharlamova M.D.

Position

Signature

Surname I.O.

HEAD OF DEPARTMENT:

Director of ES&PQM
Department

Savenkova E.V.

Position

Signature

Name, Surname

HEAD OF PROGRAM:

Associate Professor of the
ES&PQM Department

Popkova A.V.

Position

Signature

Name, Surname