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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**

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## **COURSE SYLLABUS**

### **Regional & Municipal MSW Management Systems**

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**Recommended by the Didactic Council for the Education Field for the specialization:  
05.04.06 "Ecology and nature management"**

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**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» (Network program with L.N. Gumilyov Eurasian National  
University)

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## 1. COURSE GOAL(s)

Formation of the theoretical foundations of solid waste management as a source of valuable secondary material resources and energy production. The principles of drawing up territorial schemes for waste management are studied, the duties and functions of regional operators are considered, the effectiveness of the introduction of an environmental fee as a regulatory tool for extended producer responsibility is analyzed. The training uses innovative learning technologies in the format of a business game and the development and protection of an industrial project, which allows you to form practical skills in the field of effective management of production and consumption waste.

## 2. REQUIREMENTS FOR COURSE OUTCOMES

Mastering the discipline "Regional & Municipal MSW Management Systems" is aimed at developing the following competencies (parts of competencies) among students::

- **General competence: GC-3.1, GC-3.2, GC-3.3;**
- **General Professional Competences: GPC-6.1; GPC-6.2; GPC-6.3;**
- **Professional Competences: GPC-1.1; GPC-1.2; GPC-3.1; GPC-3.2**

| Code          | Code and name of the graduate's competence   | Code and name of the indicator of achievement of competence   |
|---------------|--|---|
| <b>GC-3</b>   | Able to organize and manage the work of the team, developing a team strategy to achieve the goal.                              | <b>GC -3.1</b> owns the techniques and methods of teamwork, organizes the selection of team members to achieve the goal;  |
|               |  | <b>GC -3.2</b> capable organize and adjust the work of the team, including on the basis of collegial decisions  |
|               |  | <b>GC-3.3</b> can delegate authority to team members and distribute assignments, give feedback on the results, take responsibility for the overall result   |
| <b>GPC -6</b> | Able to design, represent, protect and disseminate the results of their professional activities, including research.           | <b>GPC-6.1</b> Able to receive, analyze, summarize the necessary scientific information using modern research methods, present their own results in the form of scientific articles and public speeches |
|               |  | <b>GPC-6.2</b> Possesses the skills of an oral report and presentation of the results of project and scientific activities, fluency in the material   |
|               |  | <b>GPC-6.3</b> Knows methodological foundations scientific research, copyright and scientific ethics requirements   |
| <b>GPC-1</b>  | Able to organize and manage the activities of the enterprise using in-depth knowledge in the field of environmental management | <b>GPC-1.1</b> Knows the basics and principles of production management, the legal framework for effective environmental management, incl. production and consumption waste management                  |
|               |  | <b>GPC-1.2</b> Able to organize the management of research, scientific and production and expert-analytical work at the enterprise  |
| <b>GPC-3</b>  | Able to develop measures for the   | <b>GPC-3.1</b> Able to predict socio-economic development based on environmental forecasts  |

|  |   |   |
|--|---|---|
|  | economic regulation of the environmental activities of the organization | <b>GPC-3.2</b> Knows how to determine the economic effect of the application of measures aimed at ensuring the environmental safety of the enterprise |
|--|---|---|

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)   |
|--------------|--|--|--|
| <b>GC-3</b>  | Able to organize and manage the work of the team, developing a team strategy to achieve the goal.                              | Environmental economics, Life safety, Technogenic systems and environmental risk   | International cooperation in the field of nature protection / International cooperation in the field of environmental protection |
| <b>GPC-6</b> | Able to design, represent, protect and disseminate the results of their professional activities, including research.           | Resource science and fundamentals of nature management, Legal foundations of nature management, Rationing and reduction of pollution in the environment, Sustainable development | -Solid Waste Management (SWM) Regulation and Legislation basics management waste   |
| <b>GPC-1</b> | Able to organize and manage the activities of the enterprise using in-depth knowledge in the field of environmental management | Recycling of production and consumption waste  | -Solid Waste Management (SWM) Regulation and Legislation basics management waste   |

|              |  |   |  |
|--------------|--|---|--|
| <b>GPC-3</b> | Able to develop measures for the economic regulation of the environmental activities of the organization | Environmental audit, Environmental management | -Basics of Circular Economics<br>circular economy<br>Green Economy and Tools for Enterprises Sustainable Development |
|--------------|--|---|--|

#### 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 |
| <i>Contact academic hours</i>                              |             |             |            |   |   |
| Lectures   | 17          |             | 17         |   |   |
| Lab works  |             |             |            |   |   |
| Seminars (workshops/tutorials)                             | 34          |             | 34         |   |   |
| <i>Self-study</i>  | 39          |             | 39         |   |   |
| <i>Evaluation and assessment (exam; pass/fail grading)</i> | 18          |             | 18         |   |   |
| <b>Total course workload</b>                               | hours       | <b>108</b>  | <b>108</b> |   |   |
|  | credits     | <b>3</b>    | <b>3</b>   |   |   |

#### 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. WORLD EXPERIENCE IN THE WASTE MANAGEMENT. POSSIBLE SCENARIOS                    | Indicators of sustainable development in the field of waste management. Basic principles of waste management. World trends in the field of waste management. Experience of developed countries<br>The main methods of integrated waste processing in the world.  | L, S           |
| 2. WASTE AS A SOURCE OF SECONDARY RESOURCES AND ENERGY                             | Goals and objectives of regional waste management programs, indicators of program implementation used, results of implementation. Short and long term programs. Regional features to be taken into account when developing programs. Waste composition. Analysis of the resource and energy potential of waste | L, S           |
| 3. MECHANISMS FOR WASTE MANAGEMENT IMPROVING (CASE OF STUDY - RUSSIAN FEDERATION). | Improving the regulatory framework in the field of waste management. Environmental collection and extended liability of producers and importers of goods. Waste disposal fee.  | L, S           |
| 4. INSTITUTE OF EXTENDED PRODUCER  | Hierarchy levels in the field of waste management. Minimization of waste generation - resource saving and low-waste technologies. Classification of  | L, S           |

| Name of the discipline section  | Contents of the section (topic)  | Type of study* |
|---|--|----------------|
| RESPONSIBILITY, ENVIRONMENTAL FEE   | municipal solid waste and organization of a separate collection system.  |                |
| 5. REGIONAL & MUNICIPAL WASTE MANAGEMENT SCHEMES.                                 | Territorial waste management schemes. Regional Operator Institute. Determination of waste streams generated in various industries and utilities. Directions of the waste management strategy: creating conditions for reducing the amount of waste; ensuring the growth of waste use volumes; creation of environmentally safe conditions for storage and disposal of waste. | L, S           |
| 6. BEST AVAILABLE TECHNIQS (BAT) FOR THE TREATMENT, DISPOSAL AND STORAGE OF WASTE | Technical reference books on BAT. Criteria for selecting BAT. Modern technologies for processing, sorting, disposal of waste. Databases and expert systems for waste management. Waste cadaster. Information mapping. Federal Classification Catalog of Waste (FCCW).  | L, S           |
| 7. INTEGRATED SCHEMES FOR THE MSW PROCESSING                                      | Complex of waste processing methods, focused on regional and industry applications. Use combinations of recycling, composting and incineration of waste. Flexibility of the waste management structure. Waste monitoring and control systems, Improving the technical level of waste processing and the creation and implementation of low-waste technologies.               | L, S           |
| 8. PRINCIPLES OF ECONOMIC REGULATION AND INCENTIVES IN WASTE MANAGEMENT.          | Payment for waste disposal (a form of compensation for damage to the environment), payment for waste disposal within the established limits and payment for over-limit disposal - from the profit of the enterprise. Economic stimulation of activities in the field of waste management. Tax and credit benefits  | L, S           |

## 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 |
| 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. |   |

| Audience type                    | Audience equipment  | Specialized educational / laboratory equipment, software and materials for mastering the discipline (if necessary) |
|----------------------------------|---|--|
|                                  |   | MS Office 2007 Prof, License No. 6842818, date of issue 09/07/2009   |
| 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. | <u>computer software complex INTEGRAL</u> (module Waste generation standards); FCCO                                |
| 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 / Modern methods of waste management, recycling and environmental protection - M. : RUDN University, 2017. - 98 p. : ill. Text/electronic course. **RUDN library**
2. Federal classification catalog of waste with a search engine: <http://kod-fkko.ru/>

### *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-management-environmental-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](http://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/](https://www.yandex.ru/)
  - Google search engine <https://www.google.ru/>
  - abstract database SCOPUS [http:// www .elsevierscience.ru/ products / scopus /](http://www.elsevierscience.ru/products/scopus/)

## 8. 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.**

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Position

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Signature

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Name, Surname

### HEAD OF DEPARTMENT:

Director of ES&PQM Department



**Savenkova E.V.**

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Position

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Signature

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Name, Surname

### HEAD OF PROGRAMME:

Senior Lecturer of the ES&PQM  
Department



**Popkova A.V.**

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Position

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Signature

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Name, Surname

**Department Environmental Safety and Product Quality Management**  
educational department to be specified

APPROVED

Department meeting protocol No \_\_\_\_\_,

Dated \_\_\_\_\_

day, month, year

Head of Educational Department

\_\_\_\_\_(Savenkova E.V.)

signature

# **ASSESSMENT TOOLKIT**

**for the course**

**Regional & Municipal MSW Management Systems**

field of studies / speciality code and title

05.04.06 "Ecology and nature management"

field of studies / speciality code and title

«Integrated Solid Waste Management» (Network program with L.N. Gumilyov Eurasian  
National University)

higher education programme profile/specialisation title

Master

graduate's qualification (degree)



**Passport to Assessment Toolkit for Course Regional & Municipal MSW Management Systems**

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

Course: Regional & Municipal MSW Management Systems

| 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 |                           |                  |                   |
|   | Module 1: WORLD EXPERIENCE IN THE WASTE MANAGEMENT. POSSIBLE SCENARIOS | Topic 1: Indicators of sustainable development in the field of waste management. Basic principles of waste management. World trends |  | 2    | 1                           | 1                    |              | 2        |  |                              |                           | 6                | 12                |

|  |  |  |  |   |   |   |  |   |  |  |  |  |   |    |
|--|--|--|--|---|---|---|--|---|--|--|--|--|---|----|
|  |  | in the field of waste management.  |  |   |   |   |  |   |  |  |  |  |   |    |
|  |  | Topic 2: Experience of developed countries The main methods of integrated waste processing in the world.   |  | 2 | 1 | 1 |  | 2 |  |  |  |  | 6 |    |
|  | Module 2: WASTE AS A SOURCE OF SECONDARY RESOURCES AND ENERGY                            | Topic 1: Goals and objectives of regional waste management programs, indicators of program implementation used, results of implementation. Short and long term programs.               |  | 2 | 1 | 1 |  | 2 |  |  |  |  | 6 | 12 |
|  |  | Topic 2: Regional features to be taken into account when developing programs. Waste composition. Analysis of the resource and energy potential of waste                                |  | 2 | 1 | 1 |  | 2 |  |  |  |  | 6 |    |
|  | Module 3: MECHANISMS FOR WASTE MANAGEMENT IMPROVING (CASE OF STUDY - RUSSIAN FEDERATION) | Topic 1: Improving the regulatory framework in the field of waste management. Environmental collection and extended liability of producers and importers of goods. Waste disposal fee. |  | 2 | 1 | 1 |  | 2 |  |  |  |  | 6 | 6  |
|  | Module 4: INSTITUTE OF EXTENDED PRODUCER RESPONSIBILITY,                                 | Topic 1: Hierarchy levels in the field of waste management. Minimization of waste generation - resource saving and low-  |  | 2 | 1 | 1 |  | 2 |  |  |  |  | 6 | 6  |

|  |  |  |  |          |          |          |  |          |  |  |  |  |          |           |
|--|--|--|--|----------|----------|----------|--|----------|--|--|--|--|----------|-----------|
|  | ENVIRONMENTAL FEE  | waste technologies. Classification of municipal solid waste and organization of a separate collection system   |  |          |          |          |  |          |  |  |  |  |          |           |
|  | Module 5: REGIONAL & MUNICIPAL WASTE MANAGEMENT SCHEMES                                  | Topic 1: Territorial waste management schemes. Regional Operator Institute. Determination of waste streams generated in various industries and utilities.  |  | <b>2</b> | <b>1</b> | <b>1</b> |  | <b>2</b> |  |  |  |  | <b>6</b> | <b>12</b> |
|  |  | Topic 2: Directions of the WM strategy: creating conditions for reducing the amount of waste; ensuring the growth of waste use volumes; creation of environmentally safe conditions for storage and disposal of waste. |  | <b>2</b> | <b>1</b> | <b>1</b> |  | <b>2</b> |  |  |  |  | <b>6</b> |           |
|  | Module 6: BEST AVAILABLE TECHNICS (BAT) FOR THE TREATMENT, DISPOSAL AND STORAGE OF WASTE | Topic 1: Technical reference books on BAT. Criteria for selecting BAT. Modern technologies for processing, sorting, disposal of waste.   |  | <b>2</b> | <b>1</b> | <b>1</b> |  | <b>2</b> |  |  |  |  | <b>6</b> | <b>12</b> |
|  |  | Topic 2: Databases and expert systems for waste management. Waste cadaster. Information mapping. Federal Classification Catalog of Waste (FCCW).   |  | <b>2</b> | <b>1</b> | <b>1</b> |  | <b>2</b> |  |  |  |  | <b>6</b> |           |

|  |  |   |  |   |    |    |    |   |    |  |  |    |    |    |
|--|--|---|--|---|----|----|----|---|----|--|--|----|----|----|
|  | Module 7:<br>INTEGRATED<br>SCHEMES FOR THE<br>MSW PROCESSING                                     | Topic 1: Complex of waste processing methods, focused on regional and industry applications. Use combinations of recycling, composting and incineration of waste.   |  | 2 | 1  | 1  |    | 2 |    |  |  |    | 6  | 12 |
|  |  | Topic 2: Flexibility of the waste management structure. Waste monitoring and control systems, Improving the technical level of waste processing and the creation and implementation of low-waste technologies |  | 2 | 1  | 1  |    | 2 |    |  |  |    |    | 6  |
|  | Module 8:<br>PRINCIPLES OF<br>ECONOMIC<br>REGULATION AND<br>INCENTIVES IN<br>WASTE<br>MANAGEMENT | Topic 1: Payment for waste disposal (a form of compensation for damage to the environment. Economic stimulation of activities in the field of waste management. Tax and credit benefits                       |  | 2 | 1  | 1  |    | 2 |    |  |  |    | 6  | 6  |
|  |  | <b>TOTAL</b>  |  |   | 26 | 13 | 13 |   | 26 |  |  | 12 | 12 | 72 |

## QUESTION CARD No 1

QUESTION 1. Waste management strategy in the light of the concept of sustainable development. Current Position Indicators

QUESTION 2 Procedure for identifying waste components

**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.

### TESTS EXAMPLES

1. The basic set of SD indicators of the current state includes:
  - a. Volumes of industrial and municipal waste (tons per year)
  - b. Volume of hazardous waste (t)
  - c. Import and export (import and export) of hazardous waste (t)
  - d. Volumes of waste (t) per capita
  - e. Land area contaminated with hazardous waste (km<sup>2</sup>)
  - f. Waste reduction rate per GNP unit (t/year)
  - g. Hazardous Waste Treatment Costs
2. The quantitative and qualitative composition of MSW depends on many factors, but the determining factors are:
  - a. climatic
  - b. natural
  - c. social
  - d. geographic
  - e. state of the art
3. The main principles of strategic waste management include:
  - a. design and planning of authorized landfills
  - b. advance forecasting of the amount, composition and ways of waste disposal at the planning stage of any production or economic activity.
  - c. design and construction of waste incinerators
  - d. preference for the use of easily recyclable materials and the simultaneous creation of conditions for the recycling of raw materials.
  - e. commitment to the existing regional waste management system,
  - f. downward trend in waste collection and disposal tax

**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 2 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 (re-exam).

**QUESTIONS FOR SELF-TRAINING**

1. Waste management strategy in the light of the concept of sustainable development. Current Position Indicators
2. Circular economy strategy. Product life cycle. Technological cycle of waste.
3. Legal regulation of waste management activities. Waste management.
4. Procedure for identifying waste components
5. Quantitative and qualitative composition of MSW. Factors affecting the generation of waste. Composition of urban MSW.
6. Production control in the field of waste management
7. Basic principles of strategic waste management, waste management hierarchy. Waste Program, implementation levels.
8. Determination of the waste hazard class. Calculation and empirical methods.

9. Integrated schemes for MSW processing. Mandatory components. Stages of implementation.
10. Production control of waste components. Control methods. Integral and specific indicators.
11. Waste management experience in developed countries: experience and comparison of management methods.
12. Federal catalog of waste. Decryption of the FCCO code.
13. Hazardous municipal waste: list, organization of separate collection, disposal methods. Russian and foreign experience.
14. Requirements for the development of draft standards for waste generation.
15. Features of regulation in the thermal processing of waste. Ecological aspects of direct waste incineration. Alternative thermal processing methods.
16. Resource characteristics of waste. Recycling technologies.
17. State cadastre of waste. Purpose, main blocks.
18. Landfill. Environmental aspects and requirements for the organization of sanitary landfills for waste disposal.
19. Legislation of Russia in the field of waste management. Goals, objectives and methods of implementation.
20. Product life cycle and waste generation. Waste as a source of secondary resources and energy
21. . Methods of economic incentives for the collection and processing of waste.
23. Territorial scheme for handling production and consumption waste.
24. Extended Producer Responsibility Institute. Ecological fee
25. Regional operator - functions, rights and obligations.
26. Assessment and selection of technologies for rational sorting of MSW (preparation for complex processing).
27. Modern technologies for the neutralization and utilization of the organic waste fraction.
28. Approaches and types of waste classification.
29. Thermal methods of solid waste disposal. Ecological and economic aspects of thermal processing
30. Federal classification catalog of waste. Purpose, principles of compilation, code structure.
31. Integrated schemes for sorting and recycling MSW. Principles and approaches.
32. Certification of hazardous waste as a tool for effective management
33. Material balances in the enterprise. Accounting for waste generation at all stages of production.

#### **Tentative list of assessment tools**

| № / №             | 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 project/report/ Library research paper /briefs * | A tool for monitoring the students' ability to present the work results to the audience.   | Themes for projects/reports/ 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,   | Examples of tasks/questions/exam question cards                            |



|                             |   |   |  |
|-----------------------------|---|---|--|
|                             |   | 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.  |  |
| 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:<br>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,<br>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,<br>c) creative level allows to evaluate and diagnose students' skills to integrate knowledge of various fields, argue their own point of view. | Set of multi-level tasks and assignments with varying difficulty |
| <b><i>Self- studies</i></b> |   |   |  |
| 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  | Themes for team-based or individual projects                     |

|   |   |   |  |
|---|---|---|--|
|   |   | 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.  |  |
| 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 team-based 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:<br>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,<br>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,<br>c) creative level allows the teacher to evaluate and diagnose students' skills to integrate knowledge of various fields, argue their own point of view. | Set of multi-level tasks and assignments with varying difficulty |

### **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.

### **Template for team-based or individual creative assignments/projects**

#### Department Environmental Safety and Product Quality Management

educational department to be specified

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

for the course Regional & Municipal MSW Management Systems

course title

#### **TASK FOR PROJECTS**

The tasks for the seminars are carried out in the form of a **collective research project**. Project work is carried out throughout the module by teams of students, the number of students in the team is 3-5 people (depending on the number of students in the study group). The purpose of teamwork is to develop and defend a study project for the selected research area. As a region, each team selects 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 municipal solid waste management. Each research team is given a task for a specific region of the world - Germany, Sweden, Finland, India, etc. Students must determine the main ideas, goals and objectives that the waste management program fulfills in the region under study. Determine the strengths and weaknesses of the program, draw a conclusion about the appropriateness of using international experience.

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\*\*Except for course work/projects

In accordance with the training plan **at the second lesson**, each team chooses a research region in Russia or abroad, analyzes the existing waste management program, the current situation in the region, determines priority types of nature management, environmental problems of the region, and sources of funding for the program.

At the **third lesson**, teams analyze the main waste streams generated in the region, the composition of MSW (morphological, fractional, energy) and assess the energy potential. **In the fourth lesson**, the teams identify the leading industrial enterprises in the area and calculate the rate of the environmental fee, analyze the measures that the management of the enterprise can take to reduce the cost of the environmental fee.

The **fifth lesson** is devoted to assessing the possibilities for improving the existing waste management system in the region (data from the territorial scheme). Team members analyze the strengths and weaknesses of the program, find bottlenecks, explore possible additional sources of funding.

**In the sixth session**, the teams determine the priority waste streams in the study area: these can be either the most significant flows in terms of generation, or the most problematic - causing environmental problems in the area. For example, in an industrial region, this can be waste from the metallurgical industry (slag), in an agricultural region, stocks of non-utilized pesticides or mineral fertilizers. Depending on the selected priority type of waste, the team proposes a way to dispose of them, taking into account the criteria for selecting the best available technology.

**At the seventh lesson**, it is necessary to analyze the existing system for collecting and transporting the main waste streams in the region, to analyze the advantages and disadvantages. Offer your own approaches to the organization of collection, accumulation and transportation, offer transportation logistics, taking into account the minimum distance to the place of processing.

**In the eighth session**, teams evaluate the economic costs for all stages of the chain for handling the selected priority waste stream, calculate the profitability of the selected method of processing the priority MSW stream and financial implementation mechanisms. This lesson is the final one. Based on the sum of points for eight lessons, the final score is set.

Self-preparation for seminars includes the collection of the necessary material and is prepared in accordance with the stage of the general task using Internet resources and factual data 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 illustrating the results obtained should be prepared for defense. The report must be performed orally, the student must be fluent in the prepared material and answer questions from the teacher and other students. At each stage, the student responsible for the preparation of the stage speaks, so by the end of the semester, each student in the group passes his stage of defense.

The final evaluation of the project work is carried out by summing up the scores received in the semester by groups.

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:**

Ass. Professor of the ES&PQM  
Department

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Position



Signature

**Kharlamova M.D.**

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Surname I.O.

**HEAD OF DEPARTMENT:**

Director of ES&PQM  
Department

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Position



Signature

**Savenkova E.V.**

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Name, Surname

**HEAD OF PROGRAM:**

Senior Lecturer of the ES&PQM  
Department

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Position



Signature

**Popkova A.V.**

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Name, Surname