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

COURSE SYLLABUS

MSW Recycling and Utilization Technics

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

05.04.06 "Ecology and Nature Management"

The course instruction is implemented within the professional education program of higher education:

«Integrated Solid Waste Management»

1.1. COURSE GOAL(s)

The goal of mastering the discipline "MSW Recycling and Utilization Technics" is the formation of knowledge, skills and abilities in the field of processing and disposal of hazardous and municipal waste, the study of technological equipment. The course program includes studying the sources of waste generation and their composition, the main types of waste, their brief description, the principles of classification and subsequent processing, methods of mechanical processing and sorting, thermal utilization, including direct (layered) combustion, various types of pyrolysis, gasification, features of incineration of solid and liquid combustible wastes. Separately, the methods of processing and disposal of sewage sludge are considered, depending on humidity, density, fluidity and contamination, as well as the processes of preparing sludge: compaction, stabilization, conditioning, dehydration, disinfection and neutralization.

2. REQUIREMENTS FOR COURSE OUTCOMES

Mastering the discipline " MSW Recycling and Utilization Technics " is aimed at developing the following competencies (parts of competencies) among students:

Table 2.1. The list of competencies formed by students in the course of mastering the discipline (the results of mastering the discipline)

Cipher	Competence	Competence achievement indicators (within this discipline)
GC-1	The ability to carry out a critical analysis of problem situations based on a systematic approach, to develop an action strategy	GC-1.1. The ability to analyze a problem situation as a system, identifying its components and relationships between them
		GC-1.2. Possession of argumentation and development of the content of a strategy for solving a problem situation based on a systematic and interdisciplinary approach
		GC-1.3. Knowledge of the basics of the strategy and identification of possible risks, suggesting ways to eliminate them
GPC-4	Ability to apply regulatory legal acts in the field of ecology and nature management, norms of professional ethics	GPC-4.1. Knowledge of the basics of environmental regulation and the fundamentals of legislation in the field of nature management
		GPC-4.2. Ability to use and apply regulatory legal acts in the field of ecology and nature management
		GPC-4.3. The ability to use the norms of professional ethics in their professional activities
PC-1	The ability to organize and manage the activities of the enterprise using in-	SPC-1.1. Knowledge of the basics and principles of production management,

Cipher	Competence	Competence achievement indicators (within this discipline)
	depth knowledge in the field of environmental management	regulatory and legal framework for effective environmental management, incl. production and consumption waste management
		SPC-1.2. Ability to organize the management of research, scientific production and expert-analytical work at the enterprise
PC-6	Ability to coordinate activities for the organization and control in the field of production and consumption waste management	SPC-.61. Ability to control activities in the field of waste management
		SPC-6.2. Availability of skills in organizing infrastructure for environmentally safe disposal and processing of production and consumption waste

As a result of course studying, the student must have:

- **knowledge** in the field of technological solutions used for the treatment and disposal of solid waste.
- **ability** to correctly classify waste, select methods of processing, sorting and disposal
- **mastering** the methods of drawing up technological schemes for the preparation and disposal of waste of different hazard classes, choosing the Best available technology for waste disposal, calculating the costs of implementing the technology.

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

Discipline "Technologies for recycling and disposal of MSW" refers to the *variable* component (Block 1).

As part of the EP VO, students also master other disciplines and / or practices that contribute to the achievement of the planned results of mastering the discipline "Technologies for recycling and disposal of MSW".

Table 3.1. The list of components of the EP HE that contribute to the achievement of the planned results of the development of the discipline

Core	Name of competence	Previous disciplines/modules, practices*	Subsequent disciplines/modules, practices*
GC-1	The ability to carry out a critical analysis of problem situations based on a systematic approach, to develop an action strategy	Methods of scientific research in ecology	Basics of Circular Economics

Core	Name of competence	Previous disciplines/modules, practices*	Subsequent disciplines/modules, practices*
GPC-4	Ability to apply normative legal acts in the field of ecology and nature management norms of professional ethics	International cooperation in the field of environmental protection Features of radioactive waste management Control and monitoring in the field of waste management Physico-chemical and analytical methods for monitoring waste components	Environmental Impact Assessment (EIA) of SWM objects
PC-1	The ability to solve the problems of professional activity in the field of ecology, nature management and nature conservation using information and communication, including geoinformation technologies	Features of radioactive waste management	Nature Protection and Accumulated Environmental Damage (AED) Elimination Tools
PC-6	Ability to develop and economically justify plans for the introduction of new equipment and technologies to ensure minimal impact of waste on the environment	Production control and monitoring in the field of waste management Physico-chemical and analytical methods for monitoring waste components	Management of environmental-economic risks

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The course workload 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>		34		34		
Lectures		17		17		
Lab works						
Seminars (workshops/tutorials)		17		17		
<i>Self-study</i>		56		56		
<i>Evaluation and assessment (exam; pass/fail grading)</i>		18		18		
Total course workload	hours	108		108		
	credits	3		3		

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*
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 industry. Secondary raw 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.	L, S
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	L, S
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).	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.	

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.	No
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.	No
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.	No

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 resource RUDN Library

2. Evans Virginia . Evans , J. _ Dooley , K. _ Rodgers . Environmental Engineering Book 1, 2, 3 / V. Newbery : Express Publishing, 2013. - 38, 40, 41 p
Textbook on the English language Library RUDN University

Additional reading:

1. Turovsky I.S. sewage sludge. Dehydration and disinfection. - M. : DeLi print, 2008, - 376 p.
2. L.G. Canin A.V. Engineering ecology: protection of the lithosphere from solid industrial and household waste. Tutorial. M., INFRA-M. 2018, -556 p.
3. L.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

4. F.M. Koroma, Kharlamova M. Waste management in African counties: social and environmental features - 2016. - No. 2. - P. 84 - 94. Article Electronic text data <http://journals.rudn.ru/ecology/article/view/12907/12337> PFUR Library
5. Doris Baah, Kharlamova M. Oilspill response on the western region of Ghana: environmental management problems [Text] - 2016. - No. 3. - P. 83 - 92. Article Electronic text data <http://journals.rudn.ru/ecology/article/view/14453/13589>
6. Applied ecobiotechnology: textbook in 2 volumes, v.1./A.E. Kuznetsov, N.B. Gradova, S.V. Lushnikov and others - M.: BINOM, Knowledge Laboratory, 2010.- 629 p.: ill.
7. Applied ecobiotechnology: textbook in 2 volumes, v.2./A.E. Kuznetsov, N.B. Gradova, S.V. Lushnikov and others. -M.: BINOM, Knowledge Laboratory, 2010.- 485 p.: ill.

Internet-based sources

1. **I-versity** 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
 - 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/)

Educational and methodological materials for independent work of students in the development of the discipline/module:*

1. A course of lectures on the discipline "MSW Recycling and Utilization Technics".

8. MID-TERM ASSESSMENT AND EVALUATION TOOLKIT

Evaluation materials and a point-rating system* for evaluating the level of competencies (parts of competencies) based on the results of mastering the discipline “MSW Recycling and Utilization Technics” are presented in the Appendix to this Work Program of the discipline.

DEVELOPER:

Ass. Professor of the ES&PQM
Department

Position



Signature

Kharlamova M.D.

Surname I.O.

HEAD OF DEPARTMENT:

Director of ES&PQM
Department

Position



Signature

Savenkova E.V.

Name, Surname

HEAD OF PROGRAMME:

Ass. Prof. of the Department

Position

Signature

Kapralova D.O.

Name, Surname