Federal State Autonomous Educational Institution for Higher Education

PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA NAMED AFTER PATRICE LUMUMBA (RUDN University)

Institute of Environmental Engineering

COURSE SYLLABUS

Modern Technologies for Nature Protection / Современные технологии защиты ОС

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 programme, specialization)

Integrated Solid Waste Management / Комплексное управление твердыми бытовыми отходами

2024

1. COURSE GOAL(s)

The course is aimed at developing the theoretical foundations of waste management as a source of valuable secondary material resources and energy production. The principles of drawing up territorial waste management schemes were studied, the responsibilities and functions of regional operators were considered, and the effectiveness of introducing an environmental tax as a regulatory instrument of extended producer responsibility was analyzed.

2. REQUIREMENTS FOR COURSE OUTCOMES

The course implementation is aimed at the development of the following competences:

Table 2.1

The list of competences

Cipher	Competence	Competence achievement indicators (within this discipline)
GC-1	Able to critically analyze problem situations based on a systematic approach and develop an action strategy	**GC-7.1** Knows how to solve problem problems and identify their components and connections between them
		GC-7.2 Able to search for solutions to a problem problem based on accessible and reliable sources of information
GPC-2.	Able to use special and new sections of ecology, geoecology and environmental management when solving scientific research and applied problems of professional activity	**GPC-2.1** Has a systematic understanding of the theoretical and methodological foundations of environmental regulation
		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
		GPC-2.3 Knows basic knowledge of fundamental sections of biology to the extent necessary to master the fundamentals of ecology and environmental management
GPC-4	Able to apply regulatory legal acts in the field of ecology and environmental management, standards of professional ethics	**GPC-4.1** Models and predicts the behavior of natural and natural-technogenic ecosystems of varying degrees of complexity, finds ways to optimize them
		GPC-4.2 Knows international practices in the development and harmonization, as well as the application of environmental standards
		GPC-4.3 Possesses skills in analyzing the need for environmental protection measures based on the application of environmental standards, skills in selecting and applying indicators for environmental assessment and forms of environmental control based on environmental standards

PC-1	the ability to formulate problems, tasks and methods of scientific research, obtain new reliable facts based on observations, experiments, scientific analysis of empirical data, abstract scientific works, compile analytical reviews of accumulated information in world science and industrial activity, summarize the results obtained in the context of previously accumulated in science knowledge and formulate conclusions and practical recommendations based on representative and original research results	**PC-1.1** Able to evaluate scientific (scientific and technical) results obtained in Russia and (or) abroad in new and (or) promising scientific areas
		PC-1.2 has the skills to evaluate the key characteristics of scientific (scientific and technical) results in the form of reviews, conclusions, reviews

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

Know:

Technological solutions used to protect the environment

Be able to:

correctly classify objects of accumulated environmental damage, reasonably select methods for reclamation and bioremediation of objects of accumulated environmental damage, evaluate the environmental and economic efficiency of ongoing activities

Possess:

techniques for drawing up schemes for comprehensive reclamation of disturbed lands and water bodies, skills in choosing the best available technology for eliminating damage to the environment.

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

Discipline " **Modern Technologies for Nature Protection / Современные технологии защиты ОС**" refers to the **mandatory block** parts 1 of the curriculum.

Within the higher education programme students also master other disciplines (modules) and / or internships that contribute to the achievement of the expected learning outcomes as results of the course. **Table 3.1**

The list of the higher education programme components that contribute to the achievement of the expected learning outcomes

Competence code	**Competence descriptor**	**Previous courses/modules, internships***	**Subsequent courses/modules, internships***
GC-1	Able to critically analyze problem situations based on a systematic approach and develop an action strategy	Methodology of Scientific Creation	Regional & Municipal MSW Management Systems Nature Protection and Accumulated Environmental Damage (AED) Elimination Tools State Exam

GPC-2.	Able to use special and new sections of ecology, geoecology and environmental management when solving scientific research and applied problems of professional activity	no	MSW Recycling and Utilization Technics Research work in the term including projects Master's Thesis Defence
GPC-4	Able to apply regulatory legal acts in the field of ecology and environmental management, standards of professional ethics		Nature Protection and Accumulated Environmental Damage (AED) Elimination Tools /
PC-1	the ability to formulate problems, tasks and methods of scientific research, obtain new reliable facts based on observations, experiments, scientific analysis of empirical data, abstract scientific works, compile analytical reviews of accumulated information in world science and industrial activity, summarize the results obtained in the context of previously accumulated in science knowledge and formulate conclusions and practical recommendations based on representative and original research results	International cooperation in the field of nature protection /	Nature Protection and Accumulated Environmental Damage (AED) Elimination Tools Master's Thesis Defence State Exam /

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The course workload of the discipline is **2** credit units

Table 4.1.

Types of educational work by periods of mastering EP VO for full -time education

Types of academic activities		**TOTAL** acc.	**Semester(s)**			
			one	**2**	**3**	**four**
Contact academic hours						
Lectures		11		11		
Lab works						
Seminars (workshops/tutorials)		11		11		
Self-study		*35*		*35*		
Evaluation and assessment (exam; pass/fail grading)		*15*		*15*		
Total course workload	hours	**72**		**72**		
	credits	**2**		**2**		

5. COURSE CONTENT

Table

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

Title of Course Modules		Content	Types of academic activities
1.	Waste problem. Waste in the environment and ecosystem stability	Concept of waste Stability and safety of the environment Stability and resistance of ecosystems to pollution.	L. S
		Ecosystem sustainability concept. The cycle of matter is an important principle of sustainable ecosystems. Biogeochemical cycles of carbon, hydrogen, oxygen, sulfur, phosphorus and metals.	
		Self-cleaning capacity of an ecosystem: biotic and abiotic processes. Parameters of ecosystem stability.	
2.	Wastewater treatment technologies	Sources and types of hydrosphere pollution. Types of wastewater Types of industrial wastewater pollution.	L. S
		Modern methods of wastewater treatment from industrial pollution.	
		Agricultural and domestic wastewater and treatment methods. Sewage sludge and methods of treatment and disposal.	
		Biological methods. Methane fermentation. Composting. Thermal methods.	
3.	Technologies for cleaning gas emissions.	Classification of gas emissions by state of aggregation Dispersity of systems (particle sizes). Solid particles - aerosols: dust and vapors. Air protection methods. .Methods for cleaning gas and dust emissions from aerosols. Dry and wet methods.	L. S
4.	Solid waste management:	Sources of solid industrial waste. Methods for neutralization and processing of industrial non-radioactive waste. Warehousing. Heat treatment Sludge processing (plating, oil). Features of recycling by industry. Sources and treatment of hazardous waste	L. S
		Features of hazardous waste. Technology for processing household waste. Combustion of solid waste. Energy generation. Ecological aspects of combustion.	L. S
		Biothermal aerobic composting technology. Technology of anaerobic digestion and biogas production.	L. S
5.	Biothermal aerobic composting technology. Anaerobic digestion and biogas production technology	Temporary storage. Storage of hazardous industrial waste. Landfills. Hygienic requirements for the selection of territory and location.	L. S
		Layout and arrangement of landfills Ensuring safety control. Features of the discharge of water-soluble liquid and combustible waste. How to choose a location for a landfill? General stages and installation of landfills.	L. S
		Modern cleaning chemical mechanical and thermal cleaning Industrial composting	L. S

6.	Technologies for rehabilitation of water bodies	Types of reservoirs. Types of water pollutants. Sources of water pollution. Water recovery methods. Stages of environmental rehabilitation of water bodies and preparatory work: technical, biological.	L. S
		Creation (restoration) of a coastal ecosystem. Comprehensive landscaping of the surrounding area. Examples. Cleaning water bodies from oil products. Reducing the concentration of pollutants in water bodies	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)
Seminar	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.	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
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

a) **Main reading:**

1. Saxena, Gaurav, R. Kishor, and R. N. Bharagava. Bioremediation of industrial waste for environmental safety. Springer Singapore, 2020..
2. Foo D. C. Y., Gopakumar S. T., Show P. L. Green Technologies: Bridging Conventional Practices and Industry 4.0. – MDPI-Multidisciplinary Digital Publishing Institute, 2020.
3. Coelho S. T. et al. (ed.). Municipal Solid Waste Energy Conversion in Developing Countries: Technologies, Best Practices, Challenges and Policy. – Elsevier, 2019.
4. Kumar S., Kalamdhad A., Ghangrekar M. M. (ed.). Sustainability in Environmental Engineering and Science: Select Proceedings of SEES 2019. – Springer, 2020.
5. Cairncross S., Feachem R. Environmental health engineering in the tropics: Water, sanitation and disease control. – Routledge, 2018.

b) **Additional reading**

1. Mihelcic J. R., Zimmerman J. B. Environmental engineering: Fundamentals, sustainability, design. – John wiley & sons, 2021.
2. Jain S. K., Singh V. P. Engineering hydrology: an introduction to processes, analysis, and modeling. – McGraw-Hill Education, 2019.
3. Salem M. A. et al. Environmental technology and a multiple approach of competitiveness //Future Business Journal. – 2020. – Т. 6. – №. 1. – С. 1-14.
4. Wang L. K. et al. (ed.). Integrated natural resources management. – Switzerland : Springer Nature, 2021. – Т. 20.

Internet-based sources

1. 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"

2. 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.elsevierscience.ru/products/scopus/

8. MID-TERM ASSESSMENT AND EVALUATION TOOLKIT

Evaluation materials and a point-rating system* for assessing the level of competence formation (part of competences) based on the results of mastering the discipline **IT in Ecology and Natural Resources Management** are presented in the Appendix to this Syllabus.

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PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA NAMED AFTER PATRICE LUMUMBA

(RUDN UNIVERSITY)

Institute of Environmental Engineering

ASSESSMENT TOOLKIT
for the course

Modern Technologies for Nature Protection / Современные технологии защиты ОС
course title
05.04.06 "Ecology and nature management"
field of studies / speciality code and title

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 отходами»

2024

Passport to Assessment Toolkit for Course Modern Technologies for Nature Protection / Современные технологии защиты ОС

Field of Studies / Speciality _05.04.06_ Ecology and nature management

code title

Course: Modern Technologies for Nature Protection / Современные технологии защиты ОС

title

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				Selfstudies		Exam/ Pass -fail		
			Oral/written survey	tes	Colloquium	Practical task	Preparation for class	Defense of course project/work	Pass/Fail assessment		
	Waste problem. Waste in the environment and ecosystem stability	Concept of waste Stability and safety of the environment Stability and resistance of ecosystems to pollution.	1	1						4	16
		Ecosystem sustainability concept. The cycle of matter is an important principle of sustainable ecosystems. Biogeochemical cycles of carbon, hydrogen, oxygen, sulfur, phosphorus and metals.	1	1						8	
		Self-cleaning capacity of an ecosystem: biotic and abiotic processes. Parameters of ecosystem stability.		2						4	
	Wastewater treatment technologies	Sources and types of hydrosphere pollution. Types of wastewater Types of industrial wastewater pollution.	2	2						4,5	13
		Modern methods of wastewater treatment from industrial pollution.								0,5	
		Agricultural and domestic wastewater and treatment methods. Sewage sludge and methods of treatment and disposal.		2						4,5	
		Biological methods. Methane fermentation. Composting. Thermal methods.		2						4,5	

	Technologies for cleaning gas emissions.	Classification of gas emissions by state of aggregation Dispersity of systems (particle sizes). Solid particles - aerosols: dust and vapors. Air protection methods. .Methods for cleaning gas and dust emissions from aerosols. Dry and wet methods.	2	2						6	6
	Solid waste management:	Sources of solid industrial waste. Methods for neutralization and processing of industrial non-radioactive waste. Warehousing. Heat treatment Sludge processing (plating, oil). Features of recycling by industry. Sources and treatment of hazardous waste	2	2						4	16
		Features of hazardous waste. Technology for processing household waste. Combustion of solid waste. Energy generation. Ecological aspects of combustion.		2						4	
		Biothermal aerobic composting technology. Technology of anaerobic digestion and biogas production.		2						4	
	Biothermal aerobic composting technology. Anaerobic digestion and biogas production technology	Temporary storage. Storage of hazardous industrial waste. Landfills. Hygienic requirements for the selection of territory and location.	2	2						6	16
		Layout and arrangement of landfills Ensuring safety control. Features of the discharge of water-soluble liquid and combustible waste. How to choose a location for a landfill? General stages and installation of landfills.	1	2						5	
		Modern cleaning chemical mechanical and thermal cleaning Industrial composting	1	2						5	
	Technologies for rehabilitation of water bodies	Types of reservoirs. Types of water pollutants. Sources of water pollution. Water recovery methods. Stages of environmental rehabilitation of water bodies and preparatory work: technical, biological.	1	2						5	10
		Creation (restoration) of a coastal ecosystem. Comprehensive landscaping of the surrounding area. Examples. Cleaning water bodies from oil products. Reducing the concentration of pollutants in water bodies	1	2						5	
	Technologies for cleaning gas emissions	. Classification of gas emissions by state of aggregation Dispersity of systems (particle sizes). Solid particles - aerosols: dust and vapors. Air protection methods. .Methods for cleaning gas and dust emissions from aerosols. Dry and wet methods.	2	2						6	6
		Total	**16**	**30**			**20**	**20**	**14**		**100**

Course Modern Technologies for Nature Protection / Современные технологии защиты ОС
course title

2. ASSESSMENT MATERIALS FOR CONDUCTING CURRENT CONTROL OF STUDENTS' PROGRESS AND INDEPENDENT WORK IN THE DISCIPLINE

Interim certification is carried out in the form of testing on the completed course. In the middle and at the end of the semester, final testing is carried out, the number of points is recorded in the BRS. Passing the exam (final scores) is included in the overall score for a maximum of 100 points. Project work is carried out during the semester by groups of students, the number of students in the group depends on the number of stages in the project. Independent 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. Defense of project work is carried out in stages at each lesson in the presence of all students in the study group. An electronic presentation illustrating the results must be prepared for the defense. The report must be completed orally, the student must be fluent in the prepared material and answer questions from the teacher and other students. At each stage, the student is responsible for preparing the stage, so by the end of the semester, each student in the group passes his own defense stage. The final assessment of project work is carried out by summing up the points received in the semester by group.

SAMPLE TOPICS FOR PERFORMING PROJECT WORK

1 Indicators of the level of economic development of the country in accordance with indices UN Sustainable Development in Waste Management
2 Main indicators of the UN SD in the field of waste management
3 Reasons for the low efficiency of processing raw materials into products (the world average is about 8%)
4 Stages and tasks of the municipal waste management system
5 Formation of a global waste management system
6 Prospects for improving the methodology for calculating environmental tax
7 Advantages, disadvantages and opportunities for improving the institution of regional operators
8 Analysis of the regional waste management system: advantages and disadvantages
9 Analysis of the specialization of the region of the Russian Federation (optional) and related problems waste management

10 Prospects for the use of thermal processing of MSW in the region (optional)
11 Solving the problem of wastewater sludge disposal in the region (optional)

SELF-STUDY QUESTIONS

1 Waste management strategy in the focus of sustainable development. Current position indicators
2 Procedure for identifying waste components
3 Quantitative and qualitative composition of solid waste. Factors influencing 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 hazard class of waste. Calculation and empirical methods.
7 Integrated schemes for processing solid waste. Required components. Implementation stages.
8 Production control of waste components. Control methods. Integral and partial indicators.
9 Waste management experience in developed countries: experience and comparison of management methods.
10 Catalogs and registers of waste. Waste code information
11 Hazardous household waste: list, organization of separate collection, disposal methods. Russian and foreign experience.
12 Requirements for the development of draft standards for waste generation.
13 Features of regulation of thermal waste processing. Environmental aspects of direct waste incineration. Alternative heat treatment methods.
14 Resource characteristics of waste. Processing technologies.
15 State waste cadastre. Purpose, main blocks.
16 Polygonal burial. Environmental aspects and requirements for the organization of sanitary landfills for waste disposal.
17 Russian legislation 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 waste collection and recycling.
21 Territorial scheme for the management of production and consumption waste.
22 Institute for Extended Producer Responsibility. 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 the neutralization and disposal of the organic fraction of waste.
26 Approaches and types of waste classification.
27 Thermal methods for neutralizing solid waste. Environmental and economic aspects of heat treatment
28 Federal classification catalog of waste. Purpose, compilation principles, code structure.
29 Integrated schemes for sorting and processing of solid waste. Principles and approaches.
30 Hazardous waste certification as a tool for effective management
31 Material balances at the enterprise. Accounting for waste generation at all stages production.

3. ASSESSMENT MATERIALS FOR INTERMEDIATE CERTIFICATION IN THE DISCIPLINE

The assessment is made as a percentage of the total number of tested tasks, with the subsequent conversion of percentages into points in accordance with the approved BRS. For example, a student answered 10 out of 15 test questions correctly, therefore he scored 67%. The maximum score for intermediate certification is 9, multiplying 0.67 by 9, we get 6 points. This item is specified in the general statement and is added to the other items.

A student is considered to have successfully passed the intermediate 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. Interim certification in the discipline "Modern technologies for nature protection" is carried out in the form of a certification test based on the results of studying the discipline/at the end of the autumn and summer semester. Types of certification test – TEST WITH ASSESSMENT (in accordance with the approved curriculum). The certification test is carried out on tickets containing three questions on the discipline course. Based on the results of the certification test, the student

Questions to prepare for the certification test in the discipline "Modern technologies for nature protection/Modern OS protection technologies":

1 The waste inventory information system includes the following main blocks:

A. database of restrictions on the location of a waste management facility
b. catalog data bank
c. database of GIS technologies and cartographic materials
d. vehicle data bank
e. investor data bank
f. data bank of waste and technologies for their processing gram. state register of waste disposal facilities
2 To determine the resource characteristics of waste, it is necessary to take into account (supplement 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 waste can be used
d. …..
e....
f. ……
3 Waste that can be used as construction and installation work and water and energy resources is generated mainly at the following stages of the product (product) life cycle:
A. product development
b. production of products
c. product sales
d. product performance e. product repair
f. waste removal
4 The main tasks of waste management in accordance with the waste management hierarchy are (put in the right order)
A. minimizing the cost of 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 into economic circulation and its material and energy use as technogenic raw materials;
d. minimizing the amount of waste generated;
e. gradual transition from landfill disposal of solid waste to industrial processing.
5 Mandatory processes that provide a comprehensive scheme for processing MSW are:
A. separate collection
b. organization of transportation without increasing the export shoulder
c. organization of transportation from equidistant objects
d. mechanical separation
e. mechanical grinding

f. biothermal treatment (composting, anaerobic digestion) gram. heat treatment

Criteria for evaluation All results of competency development are assessed in accordance with the scale of the international scoring system ECTS. In accordance with the calculated grading system (* see toolkit passport), the student gains the required points. Class work (for one hour of class): no more than 1 point. The grade is given for presence and active work at a seminar or lecture (lectures are held in an interactive form) - answers to current questions, notes, discussion. Independent preparation for the lesson: maximum 3 points for each topic. The topic is prepared, there is a presentation, calculation results, the student answers questions freely - 2 points; the student is present in 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

The final exam is taken by students voluntarily if they have scored the minimum possible score for certification - 51 points. In other cases, the exam is mandatory and is worth a maximum of 14 points. As a result, the total score is calculated taking into account the result of 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 failed and the student can take it again (re-examination).

Response Evaluation Criteria	**Points**		
	The answer does not meet the criterion	**The answer partially meets the criterion**	**The answer fully meets the criterion**
The student gives an answer without leading questions from the teacher	0	1-2	3
The student practically does not use the prepared answer manuscript	0	1-2	3
The answer shows the teacher's confident knowledge of the terminological and methodological apparatus of the discipline/module	0	1-2	3
The answer has a clear logical structure	0	1-2	3
The answer shows the student's understanding of the connections between the subject of the question and other sections of the	0	1-2	2

discipline/module and/or other disciplines/modules of the EP			
			14

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