PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA NAMED AFTER PATRICE LUMUMBA

Institute of Environmental Engineering

(наименование основного учебного подразделения (ОУП)-разработчика ОП ВО)

COURSE SYLLABUS

Modern remediation technologies

(наименование дисциплины/модуля)

Recommended by the Methodological Council for the Education Field:

05.04.06 Ecology and nature management

(код и наименование направления подготовки/специальности)

The discipline is mastered within the framework of the main professional higher education program:

Economics of natural resources management

(наименование (профиль/специализация) ОП ВО)

2023

1. COURSE GOALS

The purpose of the discipline is to get acquainted with modern theoretical basics and practical approaches and technologies for the remediation of polluted and disturbed environmental systems.

2. LEARNING OUTCOMES

The mastering of the discipline "Modern remediation technologies" is aimed at the formation of the following competencies (parts of competencies) in students:

Table 2.1. List of competencies formed by students during the development of the discipline (LEARNING OUTCOMES)

Code	Competence	Indicators of competence achievement (within the framework of this discipline)
GC -2	able to manage the project at all stages of its life cycle.	**GC -2.1** able to formulate a project task based on the problem posed and the way to solve it
		GC-2.2 able to develop a project concept, formulates a goal, tasks, justifies the relevance, expected results and scope of their application
		GC-2.3 knows how to develop a project implementation plan taking into account possible risks, plans the necessary resources
GPC-2	Able to use special and new sections of ecology, geoecology and nature management in solving research and applied problems of professional activity.	**GPC -2.1** Knows the basics of ecology, geoecology, environmental economics and circular economy, as well as environmental management
		GPC -2.2 Able to use environmental, economic and other special knowledge and algorithms to solve professional problems
		GPC -2.3 Able to find, analyze and competently use the latest information and modern techniques in the performance of research and applied tasks
GPC-3	Able to apply environmental research methods to solve research and applied problems of professional activity	**GPC -3.1** Knows the principles and methods of environmental monitoring of environmental components
		GPC -3.2 Owns analytical methods for monitoring pollutants and physical impacts and processing the information received
		GPC -3.3 Able to develop systems for environmental monitoring and control in production and solve applied problems in professional activities
SPC -3	Possession of the basics of design, expert-analytical activities and research using modern approaches and methods, equipment and computer systems	SPC-3.1 Able to plan the introduction of modern approaches and methods, equipment and computing systems to solve problems in the professional field
		PC-3.2 Owns the basics of design and expert-analytical activities
SPC-5	Able to develop standard environmental measures and assess the impact of planned facilities or other	SPC-5.1 Able to develop and plan the implementation of standard environmental measures, taking into account international practice and the requirements of national legislation

Code	Competence	Indicators of competence achievement (within the framework of this discipline)
	forms of economic activity on the environment	SPC-5.2. Has the skills to assess the impact of planned structures or other forms of economic activity on the environment
		SPC-5.3 Knows the requirements for the preparation and implementation of programs for the environmental modernization of enterprises, the introduction of BAT, the organization of environmental monitoring, accounting and reporting
SPC-6	Able to develop standard environmental measures and assess the impact of planned facilities or other forms of economic activity on the environment	**SPC-6.1** Capable of detecting inconsistencies in the state of environmental components with the requirements of national and international standards
		SPC-6.2 Able to develop programs for monitoring natural complexes under conditions of technogenic loads and programs for environmental rehabilitation of territories

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The discipline "Modern remediation technologies " refers to Compulsory Disciplines of the Higher Education Program.

Within the framework of the higher education program, students also master other disciplines and/or practices that contribute to expected learning outcomes of the discipline "Modern remediation technologies ".

Table 3.1. List of Higher Education Program components that contribute to expected learning outcomes

Code	Competence	Previous Disciplines (Modules)	Subsequent Disciplines (Modules)
GC -2	able to manage the project at all stages of its life cycle.	Management of environmental-economic risks / Управление эколого-экономическими рисками Management of natural resources / Менеджмент природных ресурсов Industrial nature management and economics / Промышленное природопользование и экономика Научно-исследовательская работа / Research work	Management of energy resources / Менеджмент ресурсов энергетики Вариативная компонента Производственная практика / Production practice НИР / Research work Учебная практика / Educational practice Преддипломная практика / Pre-graduate practice
GPC -2	Able to use special and new sections of ecology, geoecology and nature management in	Estimations of natural resources / Оценки природных ресурсов Economic aspects of natural resources management /	Methodology of scientific creation / Методология научного творчества Modern technologies for nature protection /

Code	Competence	Previous Disciplines (Modules)	Subsequent Disciplines (Modules)
	solving research and applied problems of professional activity..	Экономические аспекты природопользования History and methology of ecology and natural resources management / История и методология экологии и природопользования Iternational collaboration / Международное сотрудничество Научно-исследовательская работа / Research work	Современные технологии защиты окружающей среды Environmental standards and nature management / Экологические стандарты и природопользование Management of water resources / Управление водными ресурсами Environmental-economic aspects of environmental projects / Эколого-экономические аспекты экологических проектов Environmental noms for sustainability / Экологические нормы для устойчивого развития Engineering ecology / Инженерная экология Monitoring of environmental impacts / Мониторинг экологических воздействий Industrial safety / Промышленная безопасность Simulation and prevention of accidents / Моделирование и предупреждение аварий Учебная практика / Educational practice Производственная практика / Production practice НИР / Research work Преддипломная практика / Pre-graduate practice
GPC-3	Able to apply environmental research methods to solve research and applied problems of professional activity	Estimations of natural resources / Оценки природных ресурсов Economic aspects of natural resources management / Экономические аспекты природопользования Научно-исследовательская работа / Research work	Modern technologies for nature protection / Современные технологии защиты окружающей среды Management of energy resources / Менеджмент ресурсов энергетики Management of water resources / Управление водными ресурсами Environmental-economic aspects of environmental projects / Эколого-

Code	Competence	Previous Disciplines (Modules)	Subsequent Disciplines (Modules)
			экономические аспекты экологических проектов Environmental noms for sustainability / Экологические нормы для устойчивого развития Standards of environmental management and occupational safety / Стандарты экологического менеджмента и охраны труда Occupational safety and HSE-audit / Охрана труда и HSE-аудит Wastes: Landfills, Processing and Recycling / Отходы: хранение, захоронение, рециклинг Surface water quality: modeling and management / Качество поверхностных вод: моделирование и менеджмент Учебная практика / Educational practice Производственная практика / Production practice НИР / Research work Преддипломная практика / Pre-graduate practice
SPC -3	Possession of the basics of design, expert-analytical activities and research using modern approaches and methods, equipment and computer systems	Estimations of natural resources / Оценки природных ресурсов Economic aspects of natural resources management / Экономические аспекты природопользования Научно-исследовательская работа / Research work	Modern technologies for nature protection / Современные технологии защиты окружающей среды Management of energy resources / Менеджмент ресурсов энергетики Environmental noms for sustainability / Экологические нормы для устойчивого развития Engineering ecology / Инженерная экология Monitoring of environmental impacts / Мониторинг экологических воздействий Учебная практика / Educational practice

Code	Competence	Previous Disciplines (Modules)	Subsequent Disciplines (Modules)
			Производственная практика / Production practice НИР / Research work Преддипломная практика / Pre-graduate practice
SPC-5	Able to develop standard environmental measures and assess the impact of planned facilities or other forms of economic activity on the environment	Estimations of natural resources / Оценки природных ресурсов Management of environmental-economic risks / Управление эколого-экономическими рисками Учебная практика / Educational practice Научно-исследовательская работа / Research work	Management of water resources / Управление водными ресурсами Environmental-economic aspects of environmental projects / Эколого-экономические аспекты экологических проектов Environmental statistics / Экологическая статистика Environmental accounting and reporting / Экологический учет и отчетность Wastes: Landfills, Processing and Recycling / Отходы: хранение, захоронение, рециклинг Surface water quality: modeling and management / Качество поверхностных вод: моделирование и менеджмент Производственная практика / Production practice НИР / Research work Преддипломная практика / Pre-graduate practice
SPC-6	Able to develop standard environmental measures and assess the impact of planned facilities or other forms of economic activity on the environment	Management of natural resources / Менеджмент природных ресурсов Modern technologies for nature protection / Современные технологии защиты окружающей среды Industrial nature management and economics / Промышленное природопользование и экономика Economic aspects of natural resources management / Экономические аспекты природопользования	Management of energy resources / Менеджмент ресурсов энергетики Environmental noms for sustainability / Экологические нормы для устойчивого развития Environmental statistics / Экологическая статистика Environmental accounting and reporting / Экологический учет и отчетность Wastes: Landfills, Processing and Recycling / Отходы:

Code	Competence	Previous Disciplines (Modules)	Subsequent Disciplines (Modules)
		Standards of environmental management and occupational safety / Стандарты экологического менеджмента и охраны труда Occupational safety and HSE-audit / Охрана труда и HSE-аудит	хранение, захоронение, рециклинг Surface water quality: modeling and management / Качество поверхностных вод: моделирование и менеджмент Industrial safety / Промышленная безопасность Simulation and prevention of accidents / Моделирование и предупреждение аварий Учебная практика / Educational practice Производственная практика / Production practice Научно-исследовательская работа / Research work НИР / Research work Преддипломная практика / Pre-graduate practice

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

Workload of the course «Modern remediation technologies » is 2 ECTS.

Table 4.1. Types of academic activities during the period of the HE program mastering

Вид учебной работы		**TOTAL**	**Semesters**			
			1	**2**	**3**	**4**
Contact academic hours		*34*				
Incl.:						
Lectures		17		17		
Lab work						
Seminars		17		17		
Self-study		*22*		*58*		
Evaluation and assessment		*16*		*16*		
Total workload	Ac.hours	**72**		**72**		
	ECTS	**2**		**2**		

5. COURSE CONTENTS

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

Name of the discipline section	**Content of the section (topics)**	**Type of academic activity***
Remediation technologies: main tasks	Remediation technologies: main tasks and characteristics; classification: physical methods;	Lectures, Seminars

and characteristics; classification	chemical methods; biological methods; in situ and ex situ technologies	
Soil remediation technologies	Soil remediation technologies: practical examples, efficiency, standards. Efficiency and risks	Lectures, Seminars
Remediation of wastewater	Remediation of wastewater: practical examples, efficiency, standards. Efficiency and risks	Lectures, Seminars
Remediation of waste landfills	Remediation of waste landfills: practical examples, efficiency, standards. Efficiency and risks	Lectures, Seminars

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom equipment and technology support requirements

Classroom for Academic Activity Type	**CLASSROOM EQUIPMENT**	**Specialized learning, laboratory equipment, software and materials for the mastering the course**
Lecture	An auditorium for conducting lecture-type classes, equipped with a set of specialized furniture; a board (screen) and technical means of multimedia presentations.	-
Seminars	Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable multimedia projector, laptop, projection screen, Stable wireless Internet connection. Software: Microsoft Windows, MS Office / Office 365, MS Teams, Chrome (latest stable release), Skype	-
Self-studies	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 an electronic information and educational environment.	-

7. RECOMMENDED SOURCES FOR COURSE STUDIES

- *Main reading:*

Sethi R., Di Molfetta A. Groundwater Engineering: A Technical Approach to Hydrogeology, Contaminant Transport and Groundwater Remediation. – Springer, 2019.

Sanyal S. K. A textbook of soil chemistry. – Daya Publishing House, A division of Astral International Pvt. Limited, 2018.

Zhang C. Soil and groundwater remediation: fundamentals, practices, and sustainability. – John Wiley & Sons, 2019.

Additional sources:

1. Sharma J. Introduction to phytoremediation–a green clean technology //Available at SSRN 3177321. – 2018.
2. Hou D. (ed.). Sustainable remediation of contaminated soil and groundwater: materials, processes, and assessment. – Butterworth-Heinemann, 2019..

Internet-sources:

1. Electronic library system of the RUDN and third-party electronic library systems, to which university students have access on the basis of concluded contracts:
- electronic library system of the RUDN University http://lib.rudn.ru/MegaPro/Web
- electronic library system «Университетская библиотека онлайн» http://www.biblioclub.ru
- electronic library system Юрайт http://www.biblio-online.ru
- electronic library system «Консультант студента» www.studentlibrary.ru
- electronic library system «Лань» http://e.lanbook.com/
- electronic library system «Троицкий мост»

2. Databases and search engines:
- electronic fund of legal and regulatory and 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/
- ……..

*Educational and methodological materials for independent work of students during the development of the discipline/ module *:*
1. A course of lectures on the discipline "Modern remediation technologies".

* - all educational and methodological materials for independent work of students are placed in accordance with the current procedure on the discipline page in the Telecommunication educational and Information System!

8. MID-TERM ASSESSMENT AND EVALUATION TOOLKIT

Evaluation materials and a point-rating system* for assessing the level of competence formation (part of competencies) based on the results of mastering the discipline "Modern remediation technologies" are presented in the Appendix to this Work Program of the discipline.

* - evaluation toolkit and ranking system are formed on the basis of the requirements of the relevant local regulatory act of the RUDN (regulations / order).

DEVELOPER:

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Position, Department	Signature	Name

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