Federal State Autonomous Educational Institution of Higher Education "Peoples' Friendship University of Russia"

(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:		Institute of Environmental Engineering
Modern remediation technologies (наименование дисциплины/модуля) Recommended by the Methodological Council for the Education Field:	(наименова	
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		(наименование дисциплины/модуля)
	Recommended by the	Methodological Council for the Education Field:
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05.04.06 Ecology and nature management (код и наименование направления подготовки/специальности)		· · · · · · · · · · · · · · · · · · ·

Economics of natural resources management

(наименование (профиль/специализация) ОП ВО)

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)

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

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

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

укономические 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 Оссираtional safety and HSE-audit / Охрана труда и HSE-ayдит Wastes: Landfills, Processin and Recycling / Отходы: хранение, захоронение, рециклинг Surface water quality: modeling and management / Качество поверхностных вод: моделирование и менеджмент Учебная практика / Educational practice	Code	Competence	Previous Disciplines	Subsequent Disciplines
экологических проектов Environmental noms for sustainability / Экологические нормы для устойчивого развития Standards of environmental management and occupational safety / Стандарты экологического менеджмента и охраны труда Оссираtional safety and HSE-audit / Охрана труда и HSE-audit / Охрана труда и HSE-ayдит Wastes: Landfills, Processin and Recycling / Отходы: хранение, захоронение, рециклинг Surface water quality: modeling and management / Качество поверхностных вод: моделирование и менеджмент Учебная практика / Educational practice Производственная практи / Production practice Производственная практик / Production practice НИР / Research work Преддипломная практика / Pre-graduate practice HIP / Research work Преддипломная практика / Pre-graduate practice HIP / Research work преддипломная практика / Pre-graduate practice HIP / Research work преддипломная практика / Pre-graduate practice ние реговарательного объектор и мобет technologies for nature protection /		- Competence	(Modules)	(Modules)
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			природных ресурсов	
			<u> </u>	защиты окружающей среды
research using resources management / Management of energy		<u> </u>		
modern approaches				
and methods, природопользования ресурсов энергетики equipment and Научно-исследовательская Environmental noms for		*	1 1	
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Engineering ecology /				Engineering ecology /
Инженерная экология				
				Monitoring of environmental
impacts / Мониторинг				ітрасія / Мониторинг экологических воздействий
Учебная практика /				
Educational practice				

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

Code	Compotonos	Previous Disciplines	Subsequent Disciplines
Code	Competence	(Modules)	(Modules)
		Standards of environmental	хранение, захоронение,
		management and	рециклинг
		occupational safety /	Surface water quality:
		Стандарты экологического	modeling and management /
		менеджмента и охраны	Качество поверхностных
		труда	вод: моделирование и
		Occupational safety and	менеджмент
		HSE-audit / Охрана труда и	Industrial safety /
		HSE-аудит	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			
		TOTAL	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 world and	Ac.hours	72		72		
Total workload	ECTS 2	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	Remediation technologies: main tasks and	Lectures,
technologies: main tasks	characteristics; classification: physical methods;	Seminars

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

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/

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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:		
Professor-consultant of the ESandPQM Department	(ay)	Khaustov A.P.
Position, Department	Signature	Name

HEAD OF THE DEPARTMENT:

Head of the Department of Environmental Safety and Product Quality Management		Savenkova E.V.
Department	Signature	Name
HAED OF THE HIGHER EDUCATION PROGRAM: Professor of the Department of Environmental Safety and Product Quality Management	<i>M</i> -	Redina M.M.
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