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**PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA  
NAMED AFTER PATRICE LUMUMBA  
Institute of Environmental Engineering**

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

**COURSE SYLLABUS**

**MODERN TECHNOLOGIES FOR NATURE PROTECTION**

(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)

## 1. COURSE GOALS

The course goal is to familiarization with modern technologies of protection of the atmosphere, water bodies, soil and land resources and technologies of waste management of production and consumption. The issues of environmental and economic efficiency of technologies, their comparative assessment and selection of the best available technologies are considered.

## 2. LEARNING OUTCOMES

The mastering of the discipline "Modern technologies for nature protection" 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)*

<b>Code</b>	<b>Competence</b>	<b>Indicators of competence achievement (within the framework of this discipline)</b>
<b>GPC -2</b>	Able to use special and new sections of ecology, geoecology and nature management in solving research and applied problems of professional activity.	<b>GPC -2.1</b> Knows the basics of ecology, geoecology, environmental economics and circular economy, as well as environmental management
		<b>GPC -2.2</b> Able to use environmental, economic and other special knowledge and algorithms to solve professional problems
		<b>GPC -2.3</b> Able to find, analyze and competently use the latest information and modern techniques in the performance of research and applied tasks
<b>GPC -3</b>	Able to apply environmental research methods to solve research and applied problems of professional activity.	<b>GPC -3.1</b> Knows the principles and methods of environmental monitoring of environmental components
		<b>GPC -3.2</b> Owns analytical methods for monitoring pollutants and physical impacts and processing the information received
		<b>GPC -3.3</b> Able to develop systems for environmental monitoring and control in production and solve applied problems in professional activities
<b>SPC -2</b>	Ability to creatively use knowledge of fundamental and applied sections of special disciplines in production and technological activities	<b>SPC-2.1</b> Ability to creatively use knowledge of fundamental and applied sections of special disciplines in production and technological activities
		<b>SPC-2.2</b> Able to organize research in applied areas of environmental protection and interpret the results obtained
<b>SPC-3</b>	Possession of the basics of design, expert-analytical activities and research using modern approaches and methods, equipment and computer systems	<b>SPC-3.1</b> Able to plan the introduction of modern approaches and methods, equipment and computing systems to solve problems in the professional field
		<b>PC-3.2</b> Owns the basics of design and expert-analytical activities
<b>SPC-6</b>	Able to develop standard environmental measures and assess the impact of	<b>SPC-6.1</b> Capable of detecting inconsistencies in the state of environmental components with the requirements of national and international standards

Code	Competence	Indicators of competence achievement (within the framework of this discipline)
	planned facilities or other forms of economic activity on the environment	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 technologies for nature protection" 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 technologies for nature protection".

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

Code	Competence	Previous Disciplines (Modules)	Subsequent Disciplines (Modules)
<b>GPC -2</b>	Able to use special and new sections of ecology, geoecology and nature management in solving research and applied problems of professional activity.	Estimations of natural resources / Оценки природных ресурсов Methodology of scientific creation / Методология научного творчества	Environmental standards and nature management / Экологические стандарты и природопользование Modern remediation technologies / Современные технологии ремедиации Economic aspects of natural resources management / Экономические аспекты природопользования Management of water resources / Управление водными ресурсами Environmental-economic aspects of environmental projects / Эколого-экономические аспекты экологических проектов Environmental norms for sustainability / Экологические нормы для устойчивого развития History and methology of ecology and natural resources management / История и методология экологии и природопользования Iternational collaboration / Международное сотрудничество Engineering ecology / Инженерная экология Monitoring of environmental impacts / Мониторинг экологических воздействий

Code	Competence	Previous Disciplines (Modules)	Subsequent Disciplines (Modules)
			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
GPC -3	Able to apply environmental research methods to solve research and applied problems of professional activity.	Estimations of natural resources / Оценки природных ресурсов	Modern remediation technologies / Современные технологии ремедиации Economic aspects of natural resources management / Экономические аспекты природопользования Management of energy resources / Менеджмент ресурсов энергетики Management of water resources / Управление водными ресурсами Environmental-economic aspects of environmental projects / Эколого-экономические аспекты экологических проектов Environmental norms 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

Code	Competence	Previous Disciplines (Modules)	Subsequent Disciplines (Modules)
			Научно-исследовательская работа / Research work НИР / Research work Преддипломная практика / Pre-graduate practice
SPC -2	Ability to creatively use knowledge of fundamental and applied sections of special disciplines in production and technological activities	Methodology of scientific creation / Методология научного творчества Научно-исследовательская работа / Research work	Engineering ecology / Инженерная экология Monitoring of environmental impacts / Мониторинг экологических воздействий Базовая компонента Учебная практика / Educational practice Производственная практика / Production practice НИР / Research work Преддипломная практика / Pre-graduate practice Защита ВКР / Protection of the final qualifying work
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 Modern technologies for nature protection / Современные технологии защиты окружающей среды	Economic aspects of natural resources management / Экономические аспекты природопользования Management of energy resources / Менеджмент ресурсов энергетики Environmental norms for sustainability / Экологические нормы для устойчивого развития Engineering ecology / Инженерная экология Monitoring of environmental impacts / Мониторинг экологических воздействий Учебная практика / Educational practice Производственная практика / Production practice Научно-исследовательская работа / Research work НИР / Research work Преддипломная практика / Pre-graduate practice
SPC-6	Able to diagnose problems of nature conservation, develop practical recommendations for its protection and	Management of natural resources / Менеджмент природных ресурсов	Industrial nature management and economics / Промышленное природопользование и экономика Environmental standards and nature management / Экологические стандарты и природопользование

Code	Competence	Previous Disciplines (Modules)	Subsequent Disciplines (Modules)
	sustainable development		Modern remediation technologies / Современные технологии ремедиации Economic aspects of natural resources management / Экономические аспекты природопользования Management of energy resources / Менеджмент ресурсов энергетики Environmental norms 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 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 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 technologies for nature protection» is 3 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			34	
Incl.:					
Lectures	18		18		
Lab work					
Seminars	18		18		
Self-study	26		26		
Evaluation and assessment	10		10		
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*
Environmental hazard of waste. The concept of ecosystem sustainability. Cycle of substances and elements	Features of interaction of xenobiotics with adiabatic components of the environment. Features of the impact of pollutants on living organisms. Environmental, physicochemical and toxicological features of priority persistent organic pollutants (POPs). The cycle and biogeochemical cycles: carbon, nitrogen, sulfur, phosphorus, metals.	Lectures, Seminars
Self-cleaning ability of ecosystems. Parameters of ecosystem sustainability	The principles of the existence of ecosystems. Homeostasis. Types of resilience. The cycle of substances and elements. Self-cleaning ability of ecosystems. Abiotic self-purification processes. Biotic self-purification processes. Soil microbiocenosis. Microbiocenosis of water bodies. Microflora of the air. The degree and speed of self-cleaning. Assimilation capacity of the ecosystem.	Lectures, Seminars
Wastewater & Sewage Treatment. Sediments of Wastewater	The main sources of wastewater. Composition and Sources of Wastewater. Types of Wastewater Pollution (according to physic and chemical properties). Atmospheric Sewage or Runoff. Household Wastewater. Modern Methods of Sewage Treatment (according to the mechanism of action). Technological Treatment Schemes	Lectures, Seminars
Gas Emissions Treatment: Modern Approaches	Classification of gas emissions based on the aggregative state. Dispersion of systems (particle sizes). Particulate matter - aerosols: dust, fumes. Methods of the air protection. Methods for cleaning of gas & dust emissions from aerosols.	Lectures, Seminars

	"Wet" cleaning of gas and dust emissions from aerosols	
Solid Waste Treatment Technologies: Secondary Raw Materials Recycling, Thermal Processing.	Pyramid of the waste management. Waste as the "secondary resources": recycling and "waste to energy" technologies. Norms for the assessment of the waste danger. Norms of the waste formation, accumulation, storage and processing	Lectures, Seminars
Landfilling	Sources of Industrial Solid Waste (ISW). Ecological Features of ISW. Methods of Industrial Nonradioactive Waste Elimination and Processing. Basic Methods of Municipal Waste Processing. Sorting and Using as Secondary Raw Materials. Rational MSW sorting scheme. "Dry" mechanical or Physical methods. The main technological indicators of the efficiency of separation of solid waste	Lectures, Seminars
Water Remediation Technologies	Types of water bodies. Types of pollutants of water bodies. Sources of water pollution. Water restoration methods. Stages of environmental remediation of water bodies and preparatory works: technical, biological. Creation (restoration) of the coastal ecosystem. Comprehensive improvement of the surrounding area. Examples. Purification of water objects from oil products. Reducing the concentration of pollutants in water bodies	Lectures, Seminars

## 6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

*Table 6.1. Classroom equipment and technology support requirements*

<b>Classroom for Academic Activity Type</b>	<b>CLASSROOM EQUIPMENT</b>	<b>Specialized learning, laboratory equipment, software and materials for the mastering the course</b>
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	-



<b>Classroom for Academic Activity Type</b>	<b>CLASSROOM EQUIPMENT</b>	<b>Specialized learning, laboratory equipment, software and materials for the mastering the course</b>
	educational environment.	

## 7. RECOMMENDED SOURCES FOR COURSE STUDIES

- *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.

- *Additional sources:*

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

- *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](http://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 technologies for nature protection".

\* - 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 technologies for nature protection" 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:

Docent of the ESandPQM  
Department

Position, Department

Signature

**Kharlamova M.D.**

Name

### HEAD OF THE DEPARTMENT:

Head of the Department of  
Environmental Safety and  
Product Quality Management

Department

Signature

**Savenkova E.V.**

Name

### HAED OF THE HIGHER EDUCATION PROGRAM:

Professor of the Department of  
Environmental Safety and  
Product Quality Management

Position, Department

Signature

**Redina M.M.**

Name