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**Federal State Autonomous Educational Institution for Higher Education  
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA NAMED AFTER PATRICE LUMUMBA  
(RUDN University)**

**Institute of Environmental Engineering**

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## **COURSE SYLLABUS**

### **Carbon Test Areas and GHG Monitoring**

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**Recommended by the Didactic Council for the Education Field of:**

05.04.06 "Ecology and Nature Management"

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

Climate Projects Management

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## 1. COURSE GOAL(s)

The course is designed to help students to obtain the complex theoretical and applied knowledge in implementation of international standards on greenhouse gas emissions and absorptions accounting, reporting and management based on the modern methodologies of their quantification and carbon footprint identification.

## • 2. REQUIREMENTS FOR LEARNING OUTCOMES

The process of studying the discipline is aimed at the formation of the following competencies:

Competence code	Competence descriptor	Competence formation indicators
GC-1	Able to carry out a critical analysis of problematic situations based on a systematic approach, develop a strategy for action	GC-1.1 able to analyze a problematic situation as a system, identifying its components and the connections between them
		GC-1.2 proficient in argumentation and develops a meaningful strategy for solving a problem situation based on systemic and interdisciplinary approaches
		GC-1.3 knows the basics of the strategy and identifies possible risks, suggesting ways to eliminate them
GPC-3	Able to apply environmental research methods to solve scientific research and applied tasks of professional activity	GPC-3.1 knows the principles and methods of environmental monitoring of environmental components
		GPC-3.2 proficient in analytical methods for controlling pollutants and physical impacts and processing the information received
		GPC-3.3 able to develop environmental monitoring and control systems at work and solve applied tasks in his professional activity
PC-4	Able to carry out an environmental analysis of projects for expansion, reconstruction, modernization of existing production facilities, taking into account the requirements of standards in the field of greenhouse gas management	PC-4.1 able to calculate the absorption/ emissions of greenhouse gases and predict their changes depending on the selected technologies
		PC-4.3 has the skills to prepare project documentation (definition of the baseline, monitoring plan), as well as documentation for validation and verification of projects
PC-5	Able to develop measures to minimize the possible risks of climate change for conducting various types of economic activities	PC-5.2 has skills in organizing the activities of carbon polygons

## 3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

Discipline *Carbon Test Areas and GHG Monitoring* refers to the **University Disciplines Module** block 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*

<b>Competence code</b>	<b>Competence descriptor</b>	<b>Previous courses/modules, internships*</b>	<b>Subsequent courses/modules, internships*</b>
<b>GC-1</b>	Able to apply regulatory legal acts in the field of ecology and environmental management, standards of professional ethics	IT in Ecology and Natural Resources Management / Компьютерные технологии и статистические методы в экологии и природопользовании Climate Project Development / Разработка климатических проектов	No
<b>GPC-3</b>	Able to carry out a critical analysis of problematic situations based on a systematic approach, develop a strategy for action	Environmental Engineering and Climate Change / Экологическая инженерия и изменение климата	No
<b>PC-4</b>	Able to carry out an environmental analysis of projects for expansion, reconstruction, modernization of existing production facilities, taking into account the requirements of standards in the field of greenhouse gas management	International Cooperation in the field of Nature Protection / Международное сотрудничество в области охраны окружающей среды International Standards for GHG Management / Международные стандарты в сфере управления парниковыми газами	No
<b>PC-5</b>	Able to develop measures to minimize the possible risks of climate change for conducting various types of economic activities	Environmental Engineering and Climate Change / Экологическая инженерия и изменение климата	Pre-graduate Internship / Преддипломная практика

#### **4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES**

The total workload of the course is **4** credit units.

*Table 4.1. Types of academic activities during the period of the HE program(me) mastering*

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>		83			83	
<i>Evaluation and assessment (exam; pass/fail grading)</i>		27			27	
<b>The total course workload</b>	hours	<b>144</b>			<b>144</b>	
	credits	<b>4</b>			<b>4</b>	

## 5. COURSE CONTENTS

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

Title of Course Modules	Content	Types of academic activities
Introduction	The role of the carbon test areas in GHG research and mitigation strategy	L, S
Data for the GHG fluxes modelling	Information basics for the GHG fluxes modelling: content, requirements, limitations for collection, processing and storage	L, S
Carbon fluxes in terrestrial ecosystems	Specificity of models and data collection. Instrumental support and monitoring methodologies	L, S
Sea carbon test areas	Specificity of models and data collection. Instrumental support and monitoring methodologies	L, S
Instruments for the carbon test areas	Observation methodologies and equipment for the carbon test areas, optimal methodologies and instruments	L, S

## 6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

*Table 6.1. Classroom equipment and technology support requirements*

Classroom for Academic Activity Type	Classroom equipment	Specialized educational / laboratory equipment, software and materials for mastering the course (if necessary)
Lecture	Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable multimedia projector, laptop, projection screen, stable wireless	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
Seminars	Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable multimedia projector, laptop, projection screen, stable wireless	

Classroom for Academic Activity Type	Classroom equipment	Specialized educational / laboratory equipment, software and materials for mastering the course (if necessary)
		Teams, Chrome (latest stable release), Skype. Microsoft Windows 7 corporate. License No. 5190227, date of issue March 16, 2010 MS Office 2007 Prof , License # 6842818, date of issue 09/07/2009
For Self-Study	Classroom for self-study (can be used for seminars and consultations), equipped with a set of devices includes laptop, stable wireless.	No

## 7. RESOURCES RECOMMENDED FOR COURSE STUDY

### *Main reading:*

1. Banerjee A, Meena RS, Jhariya MK, Yadav DK, editors. Agroecological footprints management for sustainable food system. Singapore: Springer; 2021.

### *Additional reading:*

1. ISO 14064-1:2018 Greenhouse gases. Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals.
2. ISO 14064-2:2019 Greenhouse gases. Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements.
3. ISO 14064-3:2019 Greenhouse gases. Part 3: Specification with guidance for the verification and validation of greenhouse gas statements.
4. ISO 14067:2018 . Greenhouse gases. Carbon footprint of products. Requirements and guidelines for quantification.
5. Krauss M, Wiesmeier M, Don A, Cuperus F, Gattinger A, Gruber S, Haagsma WK, Peigné J, Palazzoli MC, Schulz F, van der Heijden MG. Reduced tillage in organic farming affects soil organic carbon stocks in temperate Europe. *Soil and Tillage Research*. 2022 Feb 1;216:105262.
6. Bertram G, Terry S. The carbon challenge: New Zealand's emissions trading scheme. Bridget Williams Books; 2021 May 24.
7. Wang H, Gu K, Dong F, Sun H. Does the low-carbon city pilot policy achieve the synergistic effect of pollution and carbon reduction?. *Energy & Environment*. 2024 Mar; 35(2):569-96.
8. Vadrevu KP, Ohara T, Justice C, editors. Biomass burning in south and Southeast Asia: impacts on the biosphere, Volume Two. CRC Press; 2021 Jun 23.
9. Krishnan R, Sanjay J, Gnanaseelan C, Mujumdar M, Kulkarni A, Chakraborty S. Assessment of climate change over the Indian region: a report of the ministry of earth sciences (MOES), government of India. Springer Nature; 2020.

10. Amon B, Çinar G, Anderl M, Dragoni F, Kleinberger-Pierer M, Hörtenhuber S. Inventory reporting of livestock emissions: The impact of the IPCC 1996 and 2006 Guidelines. Environmental Research Letters. 2021 Jun 22;16(7):075001.
11. Zaman M, Heng L, Müller C. Measuring emission of agricultural greenhouse gases and developing mitigation options using nuclear and related techniques: Applications of nuclear techniques for GHGs. Springer Nature; 2021.
12. Bhandari MP. Getting the climate science facts right: The role of the IPCC. River Publishers; 2022 Sep 1.

#### *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](http://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/](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/)

## **8. ASSESSMENT TOOLKIT AND GRADING SYSTEM FOR EVALUATION OF STUDENTS' COMPETENCES LEVEL UPON COURSE COMPLETION**

The assessment toolkit and the grading system to evaluate the level of competences (competences in part) formation as results of mastering the discipline are specified in the Appendix to the syllabus.

### **DEVELOPER:**

Professor of the ES&PQM Department		<b>Redina M.M.</b>
Position	Signature	Name, Surname

### **HEAD OF DEPARTMENT:**

Director of ES&PQM Department		<b>Savenkova E.V.</b>
Position	Signature	Name, Surname

### **HEAD OF PROGRAMME:**

Director of ES&PQM Department		<b>Savenkova E.V.</b>
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**ASSESSMENT TOOLKIT**

**Carbon Test Areas and GHG Monitoring**

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**Recommended by the Didactic Council for the Education Field of:**  
05.04.06 "Ecology and nature management"

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higher education:**

Climate Project Management

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## Passport to Assessment Toolkit for Course Carbon Test Areas and GHG Monitoring

Education Field / Speciality 05.04.06 "Ecology and nature management"/ «Climate Projects Management»

Course: Carbon Test Areas and GHG Monitoring

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 course
			Class work					Self-studies				Exam/Pass-fail assessment		
			Quiz	Test	Work with lecture materials	Work at the seminars	Lab work	Homework	Research essay/ Library research paper/ Presentation	Calculation and graphic work	Group work project			
GC-1 GPC-3 PC-4 PC-5	Introduction	The role of the carbon test areas in GHG research and mitigation strategy	2		2	2							6	6
GC-1 GPC-3 PC-4 PC-5	Data for the GHG fluxes modelling	Information basics for the GHG fluxes modelling: content, requirements, limitations for collection, processing and storage	2		2	2							6	6



GC-1 GPC-3 PC-4 PC-5	Carbon fluxes in terrestrial ecosystems	Specificity of models and data collection. Instrumental support and monitoring methodologies	2		4	4							10	10
GC-1 GPC-3 PC-4 PC-5	Sea carbon test areas	Specificity of models and data collection. Instrumental support and monitoring methodologies	2		2	2							6	6
GC-1 GPC-3 PC-4 PC-5	Instruments for the carbon test areas	Observation methodologies and equipment for the carbon test areas, optimal methodologies and instruments	2		4	2							8	8
		<b>TOTAL</b>	<b>10</b>		<b>14</b>	<b>12</b>			<b>20</b>		<b>30</b>	<b>14</b>	<b>34</b>	<b>100</b>

## Course Carbon Test Areas and GHG Monitoring

### QUESTION CARD No 1

QUESTION 1. GHG monitoring methodologies: main requirements and limitations.

QUESTION 2. Carbon test areas in Russia: possibilities for the implementation of the experience in other countries.

3 \* .....

**Developer** \_\_\_\_\_ (Redina Margarita)  
signature

Head of Educational Department \_\_\_\_\_ (Savenkova Elena)  
signature

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day, month, year

Note \* Practice case/task inclusion is subject to the teacher's discretion.

The set of exam question cards is complemented by the assessment criteria developed by the teacher and approved at the department meeting.

Assessment criteria:

*(in compliance with the legal regulations in force)*

### EXAM QUESTIONS

1. Methodologies for the GHG monitoring.
2. Main components of the GHG flux in soil and approaches to their monitoring
3. Main components of the GHG flux in the terrestrial ecosystem and approaches to their monitoring.
4. Main components of the GHG flux in a marine ecosystem and approaches to their monitoring.
5. Russian network of the carbon test areas.
6. Approaches to the selection of sites for the carbon test areas.
7. Limitations of remote methods in GHG monitoring.
8. Main indicators to be controlled in the terrestrial ecosystems.
9. Main indicators to be controlled in the marine ecosystems
10. Requirements to the environmental monitoring data.
11. Instruments for the carbon test area supporting.
12. Application of the GHG monitoring data.
13. Justification of the representativeness of the carbon test area site.
14. GHG monitoring data processing: methods, limitations.
15. GHG inventories on the base of a GHG monitoring: the Russian experience.

### Tentative list of assessment tools

No	Assessment tool	Brief features	Assessment tool representation in the kit
<i>Class work</i>			
1	Survey/Quiz	A tool of control, organised as a special conversation between a teacher and students on topics related to the course under study, and designed to clarify the amount of students' knowledge in a particular section, topic, problem, etc.	Questions on the course topics /modules
2	Test	A system of standardised tasks that allows the teacher to automate the procedure for measuring the student's level of knowledge and skills	Tests bank
3	Control work	A tool of control organised as a classroom lesson, at which students need to independently demonstrate the acquisition and mastering of the educational material of the course topic, section, or sections.	Questions on the course topics /modules
4	Round table, discussion, polemic, dispute, debate, (class work)	Evaluation tools that allow the teacher to engage students in the process of discussing controversial issues, problems and assess their ability to argue their own point of view.	List of themes for round tables, discussions, polemics, disputes, debates.
5	Business game and/or role play	Joint activities of a student group under the teacher's control to solve educational and professionally oriented tasks through the simulation of a real-world problem; this activity allows the teacher to assess the students' ability to analyse and solve typical professional challenges.	Topic (problem), concept, roles and expected results for each game
6.	Presentation (defence) of project/report/ Library research paper /briefs *	A tool for monitoring the students' ability to present the work results to the audience.	Themes for projects/reports/ Library research paper/ briefs
7	Pass/Fail assessment	A tool for checking the quality of students' performance of laboratory work, acquisition and mastering of the practice training and seminar educational material, successful completion of the advanced field internship and pre-graduate internship and fulfillment of all training assignments in the course of these internships in accordance with the approved programme.	Tasks examples
8	Exam	The evaluation of the student's work during the semester (year, the entire period of study, etc.); it is designed to identify the level, soundness and systematic nature of theoretical and practical knowledge gained by the student, formation of independent work skills, development of creative	Examples of tasks/questions/exam question cards

		thinking, ability to synthesise the acquired knowledge and apply it to solve practice tasks.	
9	Case	A problem-solving task in which the student is asked to comprehend the real work-related (occupational) situation necessary to solve the problem.	Assignments to solve the case
10	Multi-level tasks and assignments with varying difficulty	The tasks and assignments differ in terms of the following levels: a) reproductive level allows the teacher to evaluate and diagnose the students' knowledge of factual material (basic concepts, algorithms, facts) and the students' ability to correctly use special terms and concepts, recognize objects of study within a certain section of the discipline, b) reconstructive level allows the teacher to evaluate and diagnose the students' abilities to synthesise, analyse, generalise factual and theoretical material and formulate specific conclusions, establish cause-and-effect relationships, c) creative level allows to evaluate and diagnose students' skills to integrate knowledge of various fields, argue their own point of view.	Set of multi-level tasks and assignments with varying difficulty
<b><i>Self- studies</i></b>			
1	Calculation and graphic work	A tool for checking students' skills in applying the acquired knowledge according to a predetermined methodology in task solving or fulfilling assignments for a module or discipline as a whole.	Set of tasks for calculation and graphic work
2	Course work/project	A type of independent written work aimed at the creative development of general professional and specialised professional disciplines (modules) and the development of relevant professional competences	Course assignment themes
3	Project	The final "product" that results from planning and performance of educational and research tasks set; it allows the teacher to assess the students' ability to independently shape their knowledge in the course of solving practice tasks and problems, navigate in the information environment and the students' level of analytical, research skills, skills of practical and creative thinking; it can be implemented individually or by a group of students.	Themes for team-based or individual projects
4	Reports, briefs	The product of the student's independent work, which is a public performance on the presentation of the results of solving a specific educational, practical, research or scientific topic.	Themes for reports, briefs
5	Standard calculations	A tool to test skills in applying the acquired knowledge, according to a predetermined methodology, solving tasks or fulfilling	Set of tasks for standard calculations

		assignments for a module or discipline as a whole.	
6	Homework	<p>The tasks and assignments differ in terms of the following levels:</p> <p>a) reproductive level allows the teacher to evaluate and diagnose the students' knowledge of factual material (basic concepts, algorithms, facts) and the students' ability to correctly use special terms and concepts, recognize objects of study within a certain section of the discipline,</p> <p>b) reconstructive level allows the teacher to evaluate and diagnose the students' abilities to synthesise, analyse, generalise factual and theoretical material and formulate specific conclusions, establish cause-and-effect relationships,</p> <p>c) creative level allows the teacher to evaluate and diagnose students' skills to integrate knowledge of various fields, argue their own point of view.</p>	Set of multi-level tasks and assignments with varying difficulty

# Department of Environmental Safety and Product Quality Management

## Set of assignments for control work

for the course **Carbon Test Areas and GHG Monitoring**

### Card 1.

- 1) What are the sources of greenhouse gases in a marine ecosystem? How can their emissions be measured?
- 2) Limitations of the remote monitoring approaches

### Assessment criteria:

*(in compliance with the legal regulations in force)*

Developer \_\_\_\_\_ (Margarita Redina)  
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day, month, year

# Department of Environmental Safety and Product Quality Management

## Set of assignments for presentation

for the course **Carbon Test Areas and GHG Monitoring**

The topics listed are preliminary; necessary to agree a with a teacher!

- 1) Practical case of a carbon test area in a region.*
- 2) Comparative assessment of the monitoring devices for the registration of carbon dioxide fluxes.*
- 3) Soil as a regulator of CO<sub>2</sub> fluxes.*
- 4) Factors affecting CO<sub>2</sub> fluxes in a marine ecosystem.*
- 5) Designing a carbon test area for the university campus.*

### **Assessment criteria:**

*(in compliance with the legal regulations in force)*

Developer \_\_\_\_\_ (Margarita Redina)  
signature

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## Department of Environmental Safety and Product Quality Management

### Team-based or individual creative assignments/projects

for the course **Carbon Test Areas and GHG Monitoring**

The purpose of the project is to develop a scheme of the carbon test area in the university campus.

A university campus situated in a megapolis is place for living and studying and at the same time a combination of urban green areas, residential and administrative buildings. A green area can be significantly affected by the urban surrounding, but it represent a general situation of the state of a “natural component” of an urban environment. Thus, it is possible to study the GHG fluxes here and to make conclusions about the contribution of green areas in a city in the total GHG exchange here.

The project is aimed on the development of a project of a carbon test area for the territory of the RUDN university taking into account the specificity of the territory and of the technogenic load here. It is necessary to select the optimal monitoring scheme, a set of equipment and approaches for the processing of collected data.

#### Algorithm

1. Get acquainted with an available information of the university campus: total area, it's functional zones, surrounding objects affecting the GHG fluxes (transport activity, possible sources of emissions; types of vegetation).
2. Suggest a monitoring scheme: content of observations, methodologies, data flows.
3. Justify a set of instrumental support of the monitoring system.
4. Suggest approaches to the data processing.
5. Present the possible collected data structure.

**Task defense form – Power Point presentation of the report.**

#### **Assessment criteria:**

*(in compliance with the legal regulations in force)*

Developer \_\_\_\_\_ (Margarita Redina)  
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