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

Carbon Cycles

Recommended by the Didactic Council for the Education Field of:
05.04.06 "Ecology and Nature Management"

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

Climate Projects Management

2024

1. COURSE GOAL(s)

The course is designed to help students to obtain the complex theoretical and applied knowledge in the components of the carbon cycle and their interrelationships, understanding the impact of modern global climate change on the carbon cycle and its reflection in the current economic situation, get acquainted with the basic methods of monitoring carbon fluxes in terrestrial spheres.

• 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
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 latest information and modern techniques in the research and applied tasks performance
PC-4	Able to conduct environmental analysis of projects for expansion, reconstruction, modernization of existing production facilities, taking into account the requirements of the greenhouse gas management standards	**PC-4.1** able to carry out calculations of greenhouse gas absorption/emissions and predict their changes depending on the selected technologies
		PC-4.2 able to develop the climate projects

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

Discipline ***Carbon Cycles*** 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

Competence code	Competence descriptor	Previous courses/modules, internships*	Subsequent courses/modules, internships*
GPC-2	Able to use special and new sections of ecology, geoecology and nature management in solving research and applied problems of professional activity	No	Climate Change Models
PC-2	Able to develop and economically argue plans for the new	No	Climate Change Models,

	environmental equipment and technology's introduction to achieve enterprise carbon neutrality		Climate Project Development, Carbon Test Areas and GHG Monitoring, Climate Neutrality and Waste Management, Research Work (R&D) (obtaining primary skills of research work), Industrial Internship, Pre-graduate Internship

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**
Contact academic hours		*34*	*34*			
Lectures		17	17			
Lab works						
Seminars (workshops/tutorials)		17	17			
Self-study		*74*	*74*			
Evaluation and assessment (exam; pass/fail grading)		*36*	*36*			
The total course workload	**144**	**144**				
	4	**4**				

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**
Module 1 Introduction to Carbon Cycles	Topic 1.1 Fundamentals of the carbon cycle	L, S
	Topic 1.2 The relationship between the components of the carbon cycle	L, S
Module 2 The impact of climate change on carbon cycles	Topic 2.1 The impact of climate change on the carbon cycle	L, S
	Topic 2.2 The impact of anthropogenic factors on the carbon cycle	L, S
Module 3 Carbon cycle management	Topic 3.1 Methods of monitoring and analysis of carbon fluxes.	L, S
	Topic 3.2 Carbon cycle management strategies to reduce emissions.	L, S
Module 4 Application of knowledge about carbon cycles in climate project management	Topic 4.1 Assessment and forecasting of the consequences of changes in the carbon cycle.	L, S
	Topic 4.2 Development and implementation of measures to adapt to changes in the carbon	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 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
Seminars	Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable multimedia projector, laptop, projection screen, stable wireless	
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. The Global CO2 Cycle: Main Processes and Interactions with Climate. https://www.researchgate.net/publication/322763934_THE_GLOBAL_CO2_CYCLE_MAIN_PROCESSES_AND_INTERACTIONS_WITH_CLIMATE

Additional reading:

1. Carbon cycle-climate feedback sensitivity to choice of the governing parameters of terrestrial carbon cycle in a climate model of intermediate complexity. https://cyberleninka.ru/article/n/carbon-cycle-climate-feedback-sensitivity-to-choice-of-the-governing-parameters-of-terrestrial-carbon-cycle-in-a-climate-model-of

2. Impact of tropospheric sulphate aerosols on the terrestrial carbon cycle. http://downloads.igce.ru/journals/FAC/FAC_2017/FAC_2017_4/Eliseev_A_V_FAC_2017_4.pdf

3. Carbon and Other Biogeochemical Cycles. (2013). https://doi.org/10.1017/cbo9781107415324.015

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. 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:

Senior lecturer of the ES&PQM Department		**Khitev Yu. P.**
Position	Signature	Name, Surname

HEAD OF DEPARTMENT:

Director of ES&PQM Department		**Savenkova E.V.**
Position	Signature	Name, Surname

HEAD OF PROGRAMME:

Director of ES&PQM Department		**Savenkova E.V.**
Position	Signature	Name, Surname

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

Institute of Environmental Engineering

ASSESSMENT TOOLKIT

Carbon Cycles

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

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

Climate Project Management

2024

Passport to Assessment Toolkit for Course Carbon Cycles

Education Field / Speciality 05.04.06 "Ecology and nature management"/ «Climate Project Management»
Course: Carbon Cycles

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**	**Calculation and graphic work**	**Group work project**			
GPC-2 PC-4	Module 1 Introduction to Carbon Cycles	Topic 1.1 Fundamentals of the carbon cycle		15	2.5			18				14	2.5	23
		Topic 1.2 The relationship between the components of the carbon cycle			2.5								2.5	
GPC-2 PC-4	Module 2 The impact of climate change on carbon cycles	Topic 2.1 The impact of climate change on the carbon cycle			2.5								2.5	20
		Topic 2.2 The impact of anthropogenic factors on the carbon cycle			2.5								2.5	

GPC-2 PC-4	Module 3 Carbon cycle management	Topic 3.1 Methods of monitoring and analysis of carbon fluxes.			2.5								2.5	23
		Topic 3.2 Carbon cycle management strategies to reduce emissions.			2.5								2.5	
GPC-2 PC-4	Module 4 Application of knowledge about carbon cycles in climate project management	Topic 4.1 Assessment and forecasting of the consequences of changes in the carbon cycle.		15	2.5			18					2.5	20
GPC-2 PC-4		Topic 4.2 Development and implementation of measures to adapt to changes in the carbon			2.5								2.5	
		TOTAL		**30**	**20**			**36**				**14**		**100**

Course Carbon Cycles

QUESTION CARD No 1

QUESTION 1. Carbon cycles: Processes in the lithosphere.
QUESTION 2. Evaluation of feedbacks in the climate-carbon cycle system.
3 * …….

Developer_____(Khitev Yurii)
signature

Head of Educational Department_____(Savenkova Elena)
signature

_____
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. The main components of the carbon cycle.
2. Processes in the biosphere: vegetation cover.
3. Processes in the biosphere: animals.
4. Processes in the biosphere: fungi and microbiota.
5. Processes in the pedosphere.
6. Processes in the lithosphere.
7. Processes in the hydrosphere.
8. The carbon cycle in the geological history of the Earth.
9. The carbon cycle in the pre-industrial world.
10. The impact of industrial civilization on the carbon cycle.
11. Forecasts of changes in the carbon cycle.
12. Reduction of carbon emissions in the energy sector.
13. Reduction of carbon emissions in industry.
14. Reduction of carbon emissions in transport.
15. Reduction of carbon emissions and enhancement of carbon sinks in agriculture and forestry.
16. Using knowledge about the carbon cycle
17. The impact of modern global climate change on the carbon cycle.
18. The main methods of studying carbon fluxes in terrestrial spheres.
19. Analysis of the relationship between modern global climate change and anthropogenic impact on the carbon cycle.
20. Evaluation of feedbacks in the climate-carbon cycle system.
21. Formulation of a scientific task for the development of production adaptation technologies to modern climate changes, taking into account the restructuring of the carbon cycle.
22. Reduction of industrial carbon emissions.
23. Reduction of carbon emissions in forestry and land use.
24. Strengthening of carbon sinks.
25. Open scientific questions in the study of the carbon cycle.

26. The role of carbon cycle components in carbon exchange between terrestrial spheres.
27. The impact of modern global climate change on various aspects of life through the impact on the carbon cycle.
28. Methods of monitoring carbon fluxes in terrestrial spheres.
29. Tracing the impact of modern climate change on various aspects of life through the impact on the carbon cycle.
30. Evaluation of feedbacks in the climate-carbon cycle system.

Tentative list of assessment tools

No	Assessment tool	Brief features	Assessment tool representation in the kit
		Class work	
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
Self- studies			
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	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 the teacher 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

Department of Environmental Safety and Product Quality Management

Set of assignments for control work

for the course Carbon Cycles

What is the carbon cycle?
a) The process of carbon transfer between the atmosphere, the Earth and living organisms.
b) The process of burning fossil fuels to produce electricity.
c) The process of carbon dioxide absorption by plants for food production.
d) The process of formation and accumulation of carbon dioxide in the atmosphere.

Where is most of the carbon stored on Earth?
a) In the atmosphere
b) In rocks and sediments
c) In the ocean
d) In living organisms

How does carbon return to the atmosphere?
a) Through the processes of photosynthesis and respiration
b) Through volcanic eruptions and forest fires
c) Through the burning of fossil fuels
d) Through all of the above mechanisms

Assessment criteria:
(in compliance with the legal regulations in force)

Developer _____ (Yurii Khitev)
signature

_____
day, month, year

Department of Environmental Safety and Product Quality Management

Business game

for the course Carbon Cycles

1 Theme (problem): taking organizational measures at an energy company to manage greenhouse gases: reducing emissions or increasing carbon capture.

2 Game conception: consider various options for carbon capture technologies. Choose the best option.

3 Roles:
- government;
- society
- non-profit organizations;
- entreasures
- bank organizations etc.

4 Expected outcomes:
Business game helps students to obtain deep understanding of:
- the possibilities of using carbon capture technologies;
- the cost of using technologies;
- the effectiveness of using various technologies.
-

Assessment criteria:
(in compliance with the legal regulations in force)

Developer _____ (Yurii Khitev)
signature

_____
day, month, year

DEVELOPER:

Senior lecturer of the ES&PQM Department		**Khitev Yu. P.**
Position	Signature	Name, Surname

HEAD OF DEPARTMENT:

Director of ES&PQM Department		**Savenkova E.V.**
Position	Signature	Name, Surname

HEAD OF PROGRAMME:

Director of ES&PQM Department		**Savenkova E.V.**
Position	Signature	Name, Surname