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

ECOSYSTEM SERVICES FOR CLIMATE CHANGE MITIGATION

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

2026

1. COURSE GOAL(s)

The course is designed to provide knowledge on mastering the basic principles of a low-carbon economy, methods and technologies for assessing the consequences of climate change on the environment.

Know:

Concept of ecosystem services Principles for valuing ecosystem services

Be able to:

Estimate the economic value of ecosystem services

Own:

skills in working with design and construction documentation; skills in working with regulatory documents

• 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
PC-3	Able to develop measures for the economic regulation of the enterprise's environmental performance, as part of the transition to a low-carbon economy	**PC-3.1** knows approaches to formulate and economically argue the management decisions on mitigation and adaptation to climate change
PC-6	Able to develop projects based on existing methods for solving geoinformation problems, use modern cloud services and analytical tools to update climate data	**PC-6.2** has the skills to assess ecosystem services for climate regulation using remote sensing

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

Course ***Ecosystem Services for Climate Change Mitigation*** refers to the **Variable component** of 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*
PC-3	Able to develop measures for the economic regulation of the enterprise's environmental performance, as part of the transition to a low-carbon economy	No	State Exam Master's Thesis Defence
PC 6	Able to develop projects based on existing methods for solving geoinformation problems, use	Remote Sensing Technics for Climate Change	State Exam Master's Thesis Defence

	modern cloud services and analytical tools to update climate data	Assesment Geoinformatics for Enterprise Carbon Neutrality	

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						
Lectures		17			17	
Lab works						
Seminars (workshops/tutorials)		17			17	
Self-study		*83*			*83*	
Evaluation and assessment (exam; pass/fail grading)		*27*			*27*	
The total course workload	hours	144			144	
	credits	**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	**Topic 1.1.** Basics of low carbon economy, main principles and definitions. net-negative carbon economy.	L, S
	Topic 1.2 Net zero, Carbon pricing for net-negative emissions	L, S
Module 2. Sustainable development	**Topic 2.1.** SD goals and indices	L, S
	Topic 2.2. Sd scenarios.	L, S
Module 3. Ecosystem services	**Topic 3.1** Ecosystem services: definition, history and importance	L, S
	Topic 3.2. Identification, quantification, and valuation	L, S
	Topic 3.3. Role in policy and management	
Module 4 Economics and ecosystem services	**Topic 4.1.** Economic approaches to ecosystem assessment. Total economic value of the ecosystem	L, S
	Topic 4.2 Economic benefits of ecosystem services. Economic effectiveness of conservation ecosystem services	L, S
	Topic 4.3 Payment s for ecosystem services	L, S
	Topic 5.1. Ecosystem services of terrestrial ecosystems	L, S
	Topic 5.2. Ecosystem services of water ecosystems	L, S
	Topic 5.3. Ecosystem services in Russian legislation	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 Johannes Bednar, Michael Obersteiner, Artem Baklanov, Marcus Thomson, Fabian Wagner, Oliver Geden, Myles Allen & Jim W. Hall Operationalizing the net-negative carbon economy 2021https://doi.org/10.1038/s41586-021-03723-9

2 Jiandong Chen, Ming Gao, Shulei Cheng, Yiyin Xu, Malin Song, Yu Liu, Wenxuan Hou & Shuhong Wang Evaluation and drivers of global low-carbon economies based on satellite data https://doi.org/10.1057/s41599-022-01171-y HUMANITIES AND SOCIAL SCIENCES COMMUNICATIONS | (2022) 9:153 |

3 Jordy Lee, 1, Morgan Bazilian, and Sara Hastings-Simon, The material foundations of a low-carbon economy One Earth 4, March 19, 2021 [a] 2021 Elsevier Inc. https://doi.org/10.1016/j.oneear.2021.02.015

4 Mark-Everard Ecosystem Services (Key Issues in Environment and Sustainability) 2nd Edition Routledge; 2nd edition (December 31, 2021) 328p

Additional reading:

1 Janet Ranganathan, Ciara Raudsepp-Hearne, Nicolas Lucas, Frances Irwin, Monika Zurek, Karen Bennett, Boyd J., Banzhaf S. What are ecosystem services? // Ecol. Economics. 2007 Vol. 63, No. 23 P. 616-626

2 Daily G.C. Introduction: What are Ecosystem Services? // Nature's Services: Societal Dependence on Natural Ecosystems / Ed by G.C. Daily. Washington (DC): Island Press, 1997 P. 1-10.

3 Daly H.E. From empty-world to full-world economics: recognizing an historical turning point in economic development // Population, Technology and Lifestyle: The Transition to Sustainability Washington (DC): Island Press, 1992 P. 29-38

4 Daly H.E. The Economics of the Steady State // Amer. Econ. Rev. 1974 Vol. 64, No. 2 P. 15-21.

5 De Groot R.S. Functions of Nature: Evaluation of Nature in Environmental Planning, Management, and Decision Making. Groningen: Wolters-Noordhoff, 1992 345 p

6 Faber S., Costanza R., Childers D.L. et al. Linking ecology and economics for ecosystem management // Bioscience. 2006 Vol. 56, No. 2 P. 121-133

7 Fisher B., Turner R.K., Morling P. Defining and classifying ecosystem services for decision making // Ecol. Econ. 2009 Vol. 68.P. 643-653.

8 Millennium Ecosystem Assessment. Ecosystems and Human Well-being. A Framework for Assessment. Washington (DC): Island Press,

9 UNEP-CBD-2000. The Ecosystem Approach: Description, Principles and Guidelines. Decisions adopted by the conference of the parties to the convention on biological diversity at its fifth meeting, Nairobi. 15-26 May 2000 unep/cbd/cop/5/23, decision v/6.

10 World Resources Institute - 2005: The Wealth of the Poor Managing Ecosystems to Fight Poverty by United Nations Development Programme, United Nations Environment Programme, The World Bank and World Resources Institute. Washington (DC): WRI, 2005 255 p. http://pdf.wri.org/wrr05_lo

11 Martin Wegmann , Jakob Schwalb-Willmann , Stefan Dech An Introduction to Spatial Data Analysis: Remote Sensing and GIS with Open Source Software (Data in the Wild) 1st Edition, Kindle Pelagic Publishing, 2020

12 Sengupta, Piyali & Choudhury, Binoy & Mitra, Sarbani & Agrawal, Krishna. (2019). Low Carbon Economy for Sustainable Development. 10.1016/B978-0-12-803581-8.11217-2

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:

Associate Professor of the EM Department		**Kapralova D.O.**
Position	Signature	Name, Surname

HEAD OF DEPARTMENT:

Director of the EM Department		**Kucher D.E.**
Position	Signature	Name, Surname

HEAD OF PROGRAMME:

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

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ASSESSMENT TOOLKIT

ECOSYSTEM SERVICES FOR CLIMATE CHANGE MITIGATION

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

2026

Passport to Assessment Toolkit for Course Ecosystem Services for Climate Change Mitigation

Education Field / Speciality 05.04.06 "Ecology and nature management"/ «Climate Project Management»
Course: Ecosystem Services for Climate Change Mitigation

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 module
			Class work								Self-studies				Exam/ Pass-		
			Quiz	Test	Colloquium	Control work	Lab work	Cases	…	…	Homework	Research essay/ Library research paper	Calculation and graphic work	Course work/project			
PC 3 PC 6	Module 1: Introduction	Topic 1: Basics of low carbon economy, main principles and definitions. net-negative carbon economy	0.5													0.5	6
		Topic 2: Net zero, Carbon pricing for net-negative emissions	0.5										5			5.5	
PC 3 PC 6		Topic 1: SD goals and indices	1										5			6	12

	Module 2: Sustainable development	Topic 2: Sd scenarios	1					5								6	
PC 3 PC 6	Module 3: Ecosystem services	Topic 1: Ecosystem services: definition, history and importance	1													1	13
		Topic 2: Identification, quantification, and valuation	1					10								11	
		Topic 3: Role in policy and management	1													1	
PC 3 PC 6	Module 4: Economics and ecosystem services	Topic 1: Economic approaches to ecosystem assessment. Total economic value of the ecosystem	1										10			11	22,5
		Topic 2: Economic benefits of ecosystem services. Economic effectiveness of conservation ecosystem services	1					5								6	
		Topic 3: Payment s for	0.5					5								5.5	

		ecosystem services															
PC 3 PC 6	Module 5: Ecosystem services assessment	Topic 1: Ecosystem services of terrestrial ecosystems	0.5										5			5.5	6.5
		Topic 2: Ecosystem services of water ecosystems	0.5													0.5	
		Topic 3: Ecosystem services in Russian legislation	0.5													0.5	
			10	**10**				**25**				**20**	**25**		**10**		**100**

Course Ecosystem Services for Climate Change Mitigation

QUESTION CARD No 1

QUESTION 1. Ecosystem services and beneficiaries
QUESTION 2. Ecosystem services of aquatic ecosystems
3 * …….

Developer_____(Kapralova Daria)
signature

Head of Educational Department_____(Kutcher Dmitryi)
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) Basic principles and definitions of a net negative carbon economy
2) Carbon pricing for net negative emissions
3) Goals and indicators of sustainable development
4) SD Scenarios
5) Ecosystem services: definition, history and significance
6) Classifications of ecosystem services.
7) Identification, quantification and evaluation.
8) The role of ecosystem services in policy and management
9) Providing services and approaches to their assessment
10) Supporting and regulating services, approaches to their analysis and evaluation
11) Types of cultural services, methods of description and evaluation
12) Public goods and international initiatives to preserve them
13) The main components of environmental-economic interaction
14) Ecological footprint as a measure of the environmental intensity of a territorial socio-economic system
15) Concept and main functions of natural capital
16) Ecosystem services and beneficiaries
17) Basic approaches to economic valuation of ecosystem services
18) Basic approaches to assessing recreational services
19) Concept and structure of national wealth
20) Ecosystem services of terrestrial ecosystems
21) Ecosystem services of aquatic ecosystems
22) Intangible ecosystem services

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 Management

Set of assignments for control work

for the course Ecosystem Services for Climate Change Mitigation

Three basic functions that natural capital performs;

a. ecosystem, aesthetic, informational
b. ecosystem, stimulating, controlling
c. resource, ecosystem, aesthetic d. resource, ecosystem, stimulating

Recreational forests include:

a. green areas around cities
b. water conservation forests
c. resort forests
d. forest reserves

Forests provide categories of ecosystem services:

a. providing
b. supportive
c. cultural
d. regulating

Reducing the level of air pollution by vegetation in urban ecosystems falls into the category;

a. providing
b. cultural
c. supportive
d. regulating

Many plants have phytoncidal properties. For example, poplar leaves kill dysentery bacillus, and fir bark kills diphtheria bacteria. Plants in this case perform an ecosystem service of the following category:

a. providing
b. regulating
c. supportive
d. cultural

The regulation of the carbon cycle and greenhouse gas fluxes by terrestrial ecosystems falls under the category of ecosystem services;

a. supportive
b. regulating
c. cultural
d. providing

Practice has shown that a fairly effective means of combating harmful emissions from motor vehicles are strips of green space along highways, the effectiveness of which can vary within a fairly wide range - from 7 to 35%. Plants in this case perform an ecosystem service of the category;

a. supportive
b. providing
c. regulating
d. cultural

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

Department of Environmental Management

Case study

for the course Ecosystem Services for Climate Change Mitigation

List of practical assignment

Practical task No. 1: evaluate the dynamics of one of the proposed indicators of sustainable development for the selected region.
Practical task No. 2: calculate your own ecological footprint
Practical task No. 3: calculate the value of forest ecosystem services
Practical task No. 4: create a survey plan to determine the selected intangible ecosystem service
Practical task No. 5: evaluate the recreational service for the selected region

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

Developer _____ (Daria Kapralova)
signature

_____
day, month, year

DEVELOPER:

Associate Professor of the EM Department		**Kapralova D.O.**
Position	Signature	Name, Surname

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Position	Signature	Name, Surname