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

LOW-CARBON ECONOMY

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 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:

Basics of a Low Carbon Economy

Be able to:

Use various indicators to assess achievement of sustainable development goals

Own:

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

• 2. REQUIREMENTS FOR COURSE 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 ***Low-carbon Economy*** refers to the **Variable component** of the 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 Assesment	State Exam Master's Thesis Defence

	modern cloud services and analytical tools to update climate data	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	**1**44			**1**44	
	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. Renewable energy sources	**Topic 3.1** Helioenergy	L, S
	Topic 3.2. Wind, Geothermal, Hydro energy	L, S
	Topic 3.3. Biofuel	
Module 4 Absolute and relative indicators,	**Topic 4.1.** Absolute indicators focused on CO_2. emissions costs	L, S
	Topic 4.2. Relative indicators based on RES	L, S
	Topic 4.3. Real GDP growth based on night-time light data.	L, S
	Topic 4.4. Low-carbon economies based on neo and reo	L, S
Module 5 Ecosystem services	**Topic 5.1.** Ecosystem services: definition, history and importance	L, S
	Topic 5.2. Identification, quantification, and valuation. Role in policy and management	L, S
Module Decarbonization technologies 6	**Topic 6.1.** Carbon neutral hydrocarbons Carbon capture and storage Combined heat and power	L, S
	Topic 6.2. Decarbonization activities by sector	L, S
	Topic 6.3. Actions taken by countries	L, S

Title of Course Modules	Content	Types of academic activities
	Topic 6.4. Low-carbon development strategy for the Russian economy	L, S
	Topic 6.5. Risks of transition to a low-carbon economy	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. Posted by Phara Guberman, Kenneth Breen, and Kaitlyn O'Malley, Cadwalader, Wickersham & Taft LLP, Climate Risk and the Transition to a Low-Carbon Economy Harvard Law School Forum on

Corporate Governance 2024 Insider Trading and Off-Channel Communications in the Age of Remote and Hybrid Work Environments (harvard.edu)

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

5. Jordy Lee, 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

Additional reading:

1. Janet Ranganathan, Ciara Raudsepp-Hearne, Nicolas Lucas, Frances Irwin, Monika Zurek, Karen Bennett, Neville Ash, Paul West Ecosystem Services A Guide for Decision Makers World Resources Institute 2008, 96p
2. Costanza, R., d'Arge, R., de Groot, R. *et al.* The value of the world's ecosystem services and natural capital. *Nature* 387, 253–260 (1997). https://doi.org/10.1038/387253a0
3. Three steps to a low-carbon economy THE GOAL OF ZERO NET EMISSIONS CAN BE ACHIEVED ORGANISATION FOR ECONOMIC CO - OPERATION AND DEVELOPMENT Policy Brief 2015 https://www.oecd.org/policy-briefs/Three-steps-to-a-low-carbon-economy.pdf

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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Institute of Environmental Engineering

ASSESSMENT TOOLKIT

LOW-CARBON ECONOMY

Recommended by the Didactic Council for the Education Field of:
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Climate Project Management

2024

Passport to Assessment Toolkit for Course Low-carbon Economy

Education Field / Speciality 05.04.06 "Ecology and nature management"/ «Climate Project Management»
Course: Low-carbon Economy

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**	**…**	**…**	**Report**	**Research essay/ Library research paper**	**Calculation and graphic work**	**Course work/project**			
PC 3 PC 6	Introduction	Basics of low carbon economy, main principles and definitions. net-negative carbon economy	0,5														
		Net zero, Carbon pricing for net-negative emissions	0,5														
PC 3 PC 6	Sustainable development	SD goals and indices	0,5					5									
		Sd scenarios	0,5														
PC 3 PC 6	Renewable energy sources	Helioenergy	0,5										10				
		Wind, Geothermal, Hydro energy	0,5					10									
		Biofuel	0,5														

PC 3 PC 6	Absolute and relative indicators,	Absolute indicators focused on CO_2 emissions costs	0,5														
		Relative indicators based on RES	0,5														
		Real GDP growth based on night-time light data	0,5										15				
		Low-carbon economies based on neo and reo	0,5														
PC 3 PC 6	Ecosystem services	Ecosystem services: definition, history and importance	0,5														
		Identification, quantification, and valuation. Role in policy and management	0,5														
PC 3 PC 6	Decarbonization technologies	Carbon neutral hydrocarbons Carbon capture and storage Combined heat and power	0,5														
		Decarbonization activities by sector	1														
		Actions taken by countries	1														
		Low-carbon development strategy for the Russian economy	0,5														
		Risks of transition to a low-carbon economy	0,5														
			10	10				15			5	20	25		15		100

Course Low-Carbon Economy

QUESTION CARD No 1

QUESTION 1. Goals and indicators of sustainable development
QUESTION 2. Decarbonization activities by sector: tertiary sector
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. Solar energy pros and cons
6. Wind power pros and cons
7. Geothermal energy pros and cons
8. Hydropower pros and cons
9. Biofuel pros and cons
10. Renewable energy pros and cons
11. Absolute indicators focused on CO2 emissions costs
12. Relative indicators based on RES
13. Real GDP growth based on night lighting data
14. Low-carbon economy based on neo and reo
15. Ecosystem services: definition, history and significance
16. Identification, quantification and evaluation.
17. The role of ecosystem services in policy and management
18. Carbon-neutral hydrocarbons
19. Carbon capture and storage
20. Combined heat and power
21. Decarbonization activities by sector: primary sector
22. Decarbonization activities by sector: secondary sector
23. Decarbonization activities by sector: tertiary sector
24. Actions taken by countries
25. Strategy for low-carbon development of the Russian economy
26. Risks of transition to a low-carbon economy

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, organized 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 standardized tasks that allows the teacher to automate the procedure for measuring the student's level of knowledge and skills	Tests bank
3.	Colloquium	A tool for monitoring the acquisition and mastering of educational material on a topic, section or sections of a discipline, organised as a training session in the form of an interview among the teacher and students.	Questions on the course topics /modules
4	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
5	Lab work	The system of practice tasks aimed at the students' practical skills formation	Practice tasks bank
6.	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.
7	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
8.	Essay	A tool that allows the teacher to assess the student's ability to express in writing the essence of the under study, to independently analyse this issue using the concepts and analytical tools of the relevant discipline, to draw conclusions that summarise his/her position on the issue under consideration.	Themes for essays
9.	Presentation (defence) of project/report/	A tool for monitoring the students' ability to present the work results to the audience.	Themes for projects/reports/

	Library research paper /briefs *		Library research paper/ briefs
10	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
11	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 thinking, ability to synthesise the acquired knowledge and apply it to solve practice tasks.	Examples of tasks/questions/exam question cards
12	Internship and research and development (R&D) report	A form of written work that allows the student to generalise his/her knowledge, skills and abilities acquired during the introductory and advanced field internships, scientific and industrial internships and R&D activities.	
13	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
14	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	Research essay (Library research paper)	The student's independent work in writing that summarises the results of the theoretical analysis of a certain scientific (educational and research) topic, where the author reveals the essence of the problem under study, considers different points of view, as well as argues his/her views on the material under consideration.	Themes for research essay (library research papers)
5	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
6	Essay and other creative assignments	A partially regulated assignment that has a non-standard solution and allows the teacher to diagnose students' skills in integrating knowledge from various fields and arguing their own point of view; it can be prepared individually or by a group of students.	Themes for team-based or individual creative assignments
7	Standard calculations	A tool to test skills in applying the acquired knowledge, according to a predetermined methodology, solving tasks or fulfilling assignments for a module or discipline as a whole.	Set of tasks for standard calculations
8	Homework	The tasks and assignments differ in terms of the following levels: a) reproductive level allows the teacher to evaluate and diagnose the students'	Set of multi-level tasks and assignments with varying difficulty

		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.	

Department of Environmental Management

Set of assignments for control work

for the course Low-Carbon Economy

What is a low carbon economy?

1) reducing carbon emissions to combat climate change
2) economics when the state has low emissions
3) low quota for emissions

What energy sources are used in a low carbon economy?

1) Only green energy
2) Green energy and fuel energy
3) Only traditional sources of energy

What does a low-carbon economy also involve, besides using green energy?

1) energy efficiency
2) sustainable practices
3) quotas for emissions
4) LCA assessment

Which countries support the transition to a low-carbon economy?

1) Russia
2) USA
3) Germany, UK, and France
4) China

What measures need to be taken to achieve a low-carbon economy at the macro level?

1) promoting renewable energy
2) carbon pricing
3) sustainable development
4) ecosystem services assessment

What does the transition to a low-carbon economy mean at the micro level?

1) individuals and businesses can reduce their carbon footprint
2) energy conservation
3) sustainable practices.

What benefits can a low-carbon economy bring?

1) reduced pollution,
2) energy security,
3) job creation
4) all answer are correct
5) no correct answer

Does a low-carbon economy affect oil demand?

1) reduce oil demand
2) no influence
3) the same oil demand but for chemistry

Why is the impact of a low-carbon economy on oil demand a concern in the global energy market?

1) Will affect oil prices
2) Will affect water market
3) Will affect geopolitics

What key changes are occurring in the global economy with increasing awareness of climate change and the promotion of a low-carbon economy?

1) Increasing awareness of climate change
2) Awarenecc of air pollution

3) Awareness of human health
4) Awatreness of hunger

Assessment criteria:

(in compliance with the legal regulations in force)

Department of Environmental Management

Case study

for the course Low-Carbon Economy

List of practical assignment

Practical task No. 1: name SD goals related to environmental objectives
Practical task No. 2: calculate a model of an energy-efficient passive house using the Energy3d program
Practical task No. 3: using maps, identify and compare energy resources for the development of the electricity sector based on renewable energy sources:
Practice task No 4: calculate GDP growth based on night lighting data.
Practical task No. 5: risks of transition to a low-carbon economy in your country

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

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.**
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