Federal State Autonomous Educational Institution of Higher Education

PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA NAMED AFTER PATRICE LUMUMBA

Agrarian and Technological Institute

educational division (faculty/institute/academy) as higher education programme developer

COURSE SYLLABUS

Green infrastructure urban climate and carbon neutrality

course title

Recommended by the Didactic Council for the Education Field of:

35.03.09 Landscape architecture
Management and design of urban green infrastructure

field of studies / speciality code and title

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

Landscape architecture

higher education programme profile/specialisation title

1. COURSE GOAL(s)

The goal of discipline «Green infrastructure urban, climate and carbon neutrality» is to provide solid fundamental knowledge in the interrelations between urban climate and C balance in urban ecosystems, as well as to master basic skills in monitoring and quantification C stocks and fluxes in urban ecosystems under various climatic conditions.

2. REQUIREMENTS FOR LEARNING OUTCOMES

The development of the discipline "Green infrastructure urban, climate and carbon neutrality" is aimed at the formation of the following competencies among students:

Table 2.1. List of competencies formed by students during the development of thediscipline (results of the development of the discipline)

Competence code	**Competence descriptor**	**Competence formation indicators** (within this course)
UC-1	Student is able to search, critically analyze problem situations based on a systematic approach, and develop a strategy for action	UC-1.1 Student is able to applysystematization to solve tasks; UC-1.2 Student is able to search and analyze information;
UC -3	Student is able to organize and managethe work of the team, developing a team strategy to achieve the goal	UC-3.1 Student is able to organize team work on the project; UC-3.2 student is ableto interact with the executive authorities to coordinate all stages of design;
UC -4	Student is able to apply modern communication technologies in thestate language of the Russian Federation and foreign language(s) for academic and professional interaction	UC-4.1 Student is able to prepare all the necessary documentation for the project inRussian and a foreign language; UC-4.2 Student is able to communicate on the project in Russian and a foreign language.
UC-5	Student is able to analyze and take into account the diversity of cultures in the process of intercultural interaction	UC-5.1 Student is able to understand the social organization of society, the specific mentality and outlook of Western and Eastern cultures UC-5.2 Student is able to overcome the cultural barrier, perceiving cross-culturaldifferences.
UC-6	Student is able to determine and implement the priorities of his own activities and ways to improve it basedon self-assessment	UC-6.1 Student is able to plan his life activities for the period of study in an educational organization; UC-6.2 Student is able to determine the tasks of self- development and professional growth, distribute them for long-medium- andshort-term with justification of their relevance and determination of the necessary resources;
	Student is able to transfer professional knowledge	GPC-2.1 Student is able to transfer professional knowledge;

Competence code	Competence descriptor	Competence formation indicators (within this course)
GPC-2	using modern pedagogical techniques;	GPC-2.2 Student is able to transfer professional knowledge using information technology.
PC-10	Readiness to manage the objects of landscape architecture in the field of their functional use, protection and conservation	PC-10.1 Readiness to manage the objects of landscape architecture in the field of their functional use, protection and conservation; PC-10.2 Ability to manage objects of landscape architecture.

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course «Green infrastructure urban, climate and carbon neutrality» refers to the variable component of (B1) block B1 of the higher educational programme curriculum.

Table 3.1. The list of the components of the educational program that contribute to theachievement of the planned results of the development of the discipline

Competence code	Competence descriptor	Previous courses/modules, Courses*	Subsequent courses/modules, Courses*
UC-1	Student is able to search, critically analyze problem situations based on a systematic approach, and develop a strategy for action.	-	Landscape planning and sustainable development; Phytopathology and Plant Protection; Landscape engineering and nature-based solution; Principles of remote sensing and modelling; Advances in environmental monitoring.
UC-3	Student is able to organize and manage the work of the team, developing a team strategy to achieve the goal.	-	Landscape planning and sustainable development; Phytopathology and Plant Protection; Landscape engineering and nature-based solution; Principles of remote sensing and modelling; Advances in environmental monitoring.
UC-4	Student is able to apply modern communication technologies in the state language of the Russian Federation and foreign language(s) for academic and professional interaction.	-	Landscape planning and sustainable development; Foreign Language; Phytopathology and Plant Protection.
UC-5	Student is able to analyze and take into account thediversity of	-	Landscape planning and sustainable development; Phytopathology and Plant

Competence code	Competence descriptor	Previous courses/modules, Courses*	Subsequent courses/modules, Courses*
	cultures in the process of intercultural interaction.		Protection; Landscape engineering and nature-based solution; Principles of remote sensing and modelling; Advances in environmental monitoring.
UC-6	Student is able to determine and implementthe priorities of his own activities and ways to improve it based on self-assessment.	-	Landscape planning and sustainable development; Phytopathology and Plant Protection; Landscape engineering and nature-based solution; Principles of remote sensing and modelling; Advances in environmental monitoring.
GPC-2	Student is able to transfer professional knowledge using modern pedagogical techniques.	-	Landscape planning and sustainable development; Phytopathology and Plant Protection; Principles of remote sensing and modelling.
PC-10	Readiness to manage the objects of landscape architecture in the field of their functional use, protection and conservation.	-	Landscape planning and sustainable development; Phytopathology and Plant Protection; Landscape engineering and nature-based solution.

4. COURSE WORKLOAD

The total workload of the course is 6 credits (216 academic hours).

5. COURSE CONTENTS

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

Modules	Contents (topics, types of practical activities)	Workload, academic hours
1. Global climate change and carbon neutrality	1.1 Global climate change and carbon neutrality	10
	1.2 Reviewing IPCC reports	
2. Urban climate	2.1 Introduction to urban meteorology	13
	2.2 Monitoring urban climate	
	2.3 Climate comfort in cities	
	2.4 Assessing heat stresses in Russian cities	
	2.5 Interim assignment on urban climate	
3. Carbon balance in urban ecosystems	3.1 C stocks in urban soils and biomass	16
	3.2 Measuring and mapping C stocks in urban	

	soils	
	3.3 Greenhouse gases emissions	
	3.4 Measuring and assessment of GHG emissions	
	3.5 Modeling and quantification of C balance	
	3.6 Accounting C balance in an urban lawn ecosystem	
	3.7 Interim assignment on urban carbon balance	
4. UGI in climate mitigation and adaptation	4.1 Cooling effect of UGI	12
	4.2 Real-time monitroing of UGI cooling effect	
	4.3 Final assignment (project)	
Independent work of students.		131
Control (exam/test with assessment).		34
	TOTAL:	**216**

6. COURSE EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

The infrastructure and technical support necessary for the course implementation include: certified soil-ecological laboratory, individual consultations, routine monitoring and interim certification, equipped with a set of specialized furniture and equipment. (rooms 203, 418). Specialized educational/laboratory equipment includes Draper Diplomat 213x213 83" tripod screen, a workstation based on a complete system unit and a monitor for working with graphical applications. Model AG_PC Axiom Group/Intel Core I3 Processor 8 Cooperative memory Crucial by Micron DDR4 8SV*2;Motherboard PRIME B360-PLUS; MoHHTop Samsung 23.5, Software ArchiCAD 15, AutoCAD12, SketchUp, QGIS 2.10 (Quantum GIS).

7. RESOURCES RECOMMENDED FOR COURSE

Basic literature:

Printed publications:

1. S. Curwell, M. Deakin, M. Symes (Eds). 2005. Sustainable Urban Development. V.1.The Framework and protocols for Environmental Assessment. Taylor & Francis Group. London.
2. M. Deakin, P. Nijkamp, G. Mitchell, R. Vreeker (Eds) 2006. Sustainable Urban Development. V.2. The Environmental Assessment Methods**.** Taylor & Francis Group. London.
3. S. Curwell, M. Deakin, P. Lombardi, G. Mitchell, R. Vreeker (Eds) 2006. Sustainable Urban Development. V.3 A toolkit for assessment. Taylor & Francis Group. London.
4. R. Valentini, J. Sievenpiper, M. Antonelli, K. Dembska. 2019. Achieving the Sustainable Development Goals Through 7 Sustainable Food Systems. Springer Nature Switzerland.

Electronic and printed full-text materials:

1. Farina A, James P, Bobryk C, Pieretti N, Lattanzi E, McWilliam J (2014) Low cost (audio) recording (LCR) for advancing soundscape ecology towards the conservation of sonic complexity and biodiversity in natural and urban landscapes. Urban Ecosyst 17:923–944 .

doi: 10.1007/s11252-014-0365-0

2. Frolova M (2019) From the Russian/Soviet landscape concept to the geosystem approach tointegrative environmental studies in an international context. Landsc Ecol 34:1485–1502 . doi: 10.1007/s10980-018-0751-8
3. Haase D, Larondelle N, Andersson E, Artmann M, Borgström S, Breuste J, Gomez-Baggethun E, Gren Å, Hamstead Z, Hansen R, Kabisch N, Kremer P, Langemeyer J, Rall EL, McPhearson T, Pauleit S, Qureshi S, Schwarz N, Voigt A, Wurster D, Elmqvist T (2014) A Quantitative Review of Urban Ecosystem Service Assessments: Concepts, Models, and Implementation. AMBIO 43:413–433 . doi: 10.1007/s13280-014-0504-0
4. Herrero-Jáuregui C, Arnaiz-Schmitz C, Herrera L, Smart SM, Montes C, Pineda FD, Schmitz MF (2019) Aligning landscape structure with ecosystem services along an urban–rural gradient. Trade-offs and transitions towards cultural services. Landsc Ecol 34:1525–1545 . doi: 10.1007/s10980-018-0756-3
5. Krause BL (1993) The niche hypothesis: a virtual symphony of animal sounds, the origins of musical expression and the health of habitats. Soundscape Newsl 6:6–10
6. Meyfroidt P, Roy Chowdhury R, de Bremond A, Ellis EC, Erb K-H, Filatova T, Garrett RD,Grove JM, Heinimann A, Kuemmerle T, Kull CA, Lambin EF, Landon Y, le Polain de Waroux Y, Messerli P, Müller D, Nielsen JØ, Peterson GD, Rodriguez García V, Schlüter M, Turner BL, Verburg PH (2018) Middle-range theories of land system change. Glob Environ Change 53:52–67 . doi: 10.1016/j.gloenvcha.2018.08.006
7. Pijanowski BC, Farina A, Gage SH, Dumyahn SL, Krause BL (2011) What is soundscape ecology? An introduction and overview of an emerging new science. Landsc Ecol 26:1213–1232 . doi: 10.1007/s10980-011-9600-8
8. Tello E, Gal?n E, Sacrist?n V, Cunfer G, Guzm?n GI, Gonz?lez de Molina M, Krausmann F, Gingrich S, Padr? R, Marco I, Moreno-Delgado D (2016) Opening the black box of energy throughputs in farm systems: A decomposition analysis between the energy returns to external inputs, internal biomass reuses and total inputs consumed (the Vall?s County, Catalonia, c.1860 and 1999). Ecol Econ 121:160–174 . doi: 10.1016/j.ecolecon.2015.11.012

Additional literature:

Electronic and printed full-text materials:

1. Aspinall R, Staiano M (2017) A Conceptual Model for Land System Dynamics as a CoupledHuman–Environment System. Land 6:81 . doi: 10.3390/land6040081
2. Cortinovis C, Geneletti D (2018a) Ecosystem services in urban plans: What is there, and what is still needed for better decisions. Land Use Policy 70:298–312 . doi: 10.1016/j.landusepol.2017.10.017
3. Cortinovis C, Geneletti D (2018b) Mapping and assessing ecosystem services to support urban planning: A case study on brownfield regeneration in Trento, Italy. One Ecosyst 3:e25477 . doi: 10.3897/oneeco.3.e25477
4. Costanza R, de Groot R, Braat L, Kubiszewski I, Fioramonti L, Sutton P, Farber S, Grasso M (2017) Twenty years of ecosystem services: How far have we come and how far do we still need to go? Ecosyst Serv 28:1–16 . doi: 10.1016/j.ecoser.2017.09.008

5. Ellis EC, Klein Goldewijk K, Siebert S, Lightman D, Ramankutty N (2010) Anthropogenic transformation of the biomes, 1700 to 2000: Anthropogenic transformation of the biomes. Glob Ecol Biogeogr no-no . doi: 10.1111/j.1466-8238.2010.00540.x
6. Elmqvist T, Fragkias M, Goodness J, Güneralp B, Marcotullio PJ, McDonald RI, Parnell S, Schewenius M, Sendstad M, Seto KC, Wilkinson C (eds) (2013) Urbanization, Biodiversityand Ecosystem Services: Challenges and Opportunities. Springer Netherlands, Dordrecht
7. Farina A (2014) Soundscape Ecology. Springer Netherlands, Dordrecht

Resources of the Internet information and telecommunication network:

1. RUDN library system: http://lib.rudn.ru:8080/MegaPro/Web University online library: http://www.biblioclub.ru
2. Ecosystem Services Partnership https://www.es-partnership.org/
3. Millennium Ecosystem Assessment https://www.millenniumassessment.org/en/index.html IQlib: http://www.iqlib.ru
4. Science Direct: http://www.sciencedirect.com EBSCO: http://search.ebscohost.com Springer/Kluwer: http://www.springerlink.com Tailor & Francis: http://www.informaworld.comRUDN web-portal

Data bases and survey systems

1. GISLAB: http://www.gis-lab.info
2. Google Earth Engine https://explorer.earthengine.google.com/#workspaceUSGS Earth Explorer https://earthexplorer.usgs.gov/
3. Copernicus Global Land Service https://land.copernicus.eu/global/products/lcGlobal Soil Map and Database https://soilgrids.org/

Educational and methodological materials for independent work of students during the development of the discipline/ module*:

1. Workbook on the discipline «Green infrastructure urban, climate and carbon neutrality».
2. Methodological guidelines for students on the development of the discipline «Green infrastructure urban, climate and carbon neutrality»

* - all teaching materials for independent work of students are placed in accordance with the currentprocedure on the discipline page in the **TUIS**!

8. ASSESSMENT TOOLKIT AND GRADING SYSTEM* FOR EVALUATION OF STUDENTS' COMPETENCES LEVEL AS COURSE RESULTS

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

* The assessment toolkit and the grading system are formed based on the requirements of the relevant local normative act of RUDN University (regulations / order).

DEVELOPERS:

Associate Professor, department of landscape planning and sustainable ecosystems		**V. I. Vasenev**
position, educational department	signature	name and surname.

HEAD OF EDUCATIONAL DEPARTMENT:

Director, department of landscape planning and sustainable ecosystems		**E. A. Dovletyarova**
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