

*Federal state autonomous educational institution higher education  
"PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA" (RUDN University)*

*Agrarian-Technological Institute*

*Approved by ISSU*

## **PROGRAM**

Discipline title    Sustainable Urban Development

Recommended for the educational direction

05.06.01 «Earth Sciences»

Program curriculum (direction)

« Green Infrastructure and Sustainable Development»

## 1. Aims and tasks of the discipline:

**Aim** - Formation of theoretical concepts and practical skills in the field of sustainable development of urban environment, taking into account environmental, socio-economic, political, cultural and educational aspects.

### Tasks:

- master the basic concepts and principles of the concept of sustainable development;
- Examine the specificities of urban ecosystems in the context of sustainable development;
- master basic approaches to analysis and assessment of ecosystem services in urban environment;
- To study the existing practices of environmental management in the city, in particular, the environmental and socio-economic conditions of the development of the city-farming;
- Familiarize students with the most modern educational practices in the field of sustainable urban development.

## 2. Place of discipline in the structure of the Educational program plan:

The discipline Sustainable Urban Development belongs to the basic part of Block 1 “Disciplines (modules)”. Table No. 1 shows the previous and subsequent disciplines aimed at the formation of the competencies of the discipline in accordance with the competency matrix of CH EP

Table 1

### Previous and subsequent disciplines aimed at the formation of competencies

№	Code and name of competency	Previous disciplines	Subsequent disciplines (groups of disciplines)
Universal competencies			
1	UC-1 ability to critically analyze and evaluate modern scientific achievements, generate new ideas when solving research and practical problems, including interdisciplinary areas  UC-2 ability to design and carry out complex research, including interdisciplinary, based on a holistic systematic scientific worldview using knowledge in the history and philosophy of science;  UC-4 readiness to use modern methods and technologies of scientific communication in national and foreign languages; including readiness to communicate in oral and written forms in Russian and foreign languages to solve professional problems, proficiency in foreign language communication	Research planning	Modeling urban ecosystem

	<p>competence in official-business, educational-professional, scientific, socio-cultural, everyday life spheres of foreign-language communication;</p> <p>UC -5 ability to plan and solve problems of own professional and personal development</p>		
<b>General professional competencies</b>			
2	<p>GPC-1 ability to independently carry out research activities in the relevant professional area using modern research methods and information and communication technologies</p> <p>GPC-2 is ready for teaching in the main educational programs of higher education.</p>	Research planning	Modeling urban ecosystem
<b>Professional competencies</b>			
3	<p>PC-1 possesses a modern scientific subject area of knowledge in the direction of the program and is able to use it for scientific, practical and pedagogical purposes</p> <p>PC-2 to be able to regulate, plan and organize quality assessment and expertise activities in urban planning</p> <p>PC-4 to be able to analyze and expertly evaluate the objects of urban planning activity</p> <p>PC-5 be able to analyze and evaluate the impact of the environment on human health and life</p> <p>PC-6 to be able to organize and manage scientific-research, scientific-production, expert-analytical works and pedagogical</p>	Research planning	Modeling urban ecosystem

### 3. Requirements for the results of mastering the discipline:

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

UC-1 is capable of critical analysis and assessment of modern scientific achievements, generation of new ideas in solving research and practical problems, including in interdisciplinary fields;

UC-2 is able to design and carry out complex researches, including interdisciplinary ones, on the basis of the integral system scientific outlook with the use of knowledge in the field of history and philosophy of science;

UC-4 is ready to use modern methods and technologies of scientific communication in the state and foreign languages; including readiness for oral and written communication in Russian and foreign languages to solve the problems of professional activity, mastery of foreign language communication competence in the official business, educational and professional, scientific, socio-cultural, everyday life spheres of foreign language communication;

UC-5 ability to plan and solve problems of own professional and personal development.

GPC-1 is able to independently carry out research activities in the relevant professional field using modern research methods and information and communication technologies;

GPC-2 is ready for teaching in the main educational programs of higher education.

PC-1 possesses a modern scientific subject area of knowledge in the direction of the program and is able to use it for scientific, practical and pedagogical purposes

PC-2 to be able to regulate, plan and organize quality assessment and expertise activities in urban planning

PC-4 to be able to analyze and expertly evaluate the objects of urban planning activity

PC-5 be able to analyze and evaluate the impact of the environment on human health and life

PC-6 to be able to organize and manage scientific-research, scientific-production, expert-analytical works and pedagogical

As a result of studying the discipline the graduate student must:

**Know:**

- the basic principles of the concept of sustainable development, taking into account the specificities of the urban environment;
- approaches to analysis and assessment of urban ecosystem services;
- examples of the application of environmental management technologies in the urban environment;

**Be able to:**

- assess the condition of the urban ecosystem based on environmental monitoring data;
- apply the data of ecological and socio-ecological analysis for assessment of urban ecosystem services;

**Master:**

- terminology used in scientific literature and normative documents (including international agreements) in the field of sustainable urban development;

- methods of ecological and socio-ecological analysis of the condition, functions and services of urban ecosystems and their components to support decision-making in the field of sustainable urban development.

#### 4. The volume of discipline and types of educational work

The discipline covers 5 ECTS.

Type of study		Total hours	Semesters		
			2		
<b>Classroom activities (total)</b>		73	73		
Including:		-	-	-	-
<i>Lectures</i>		24	24		
<i>Practical Activities (PP)</i>		49	49		
<i>Seminars (S)</i>					
<i>Labs (L)</i>					
<b>Individual work (total)</b>		100	100		
<b>Control</b>		7	7		
Total labor time hour		180	180		
hours					
ECTS		5	5		

#### 5. Discipline content

##### 5.1. Contents of the discipline sections

№ п/п	The name of the discipline section	The content of the section (topic)
1.	Urbanization and sustainable development	Sustainable development: history, principles and terminology of the concept. International agreement and regulations in sustainable development (Millennium Development Goals, Sustainable Development Goals of United Nations). Urbanization as a social, economic and ecological phenomena. Ecosystems, geosystems and landscapes: differences and synergies of the concepts. Anthropocene and urban society. Human development index. Biomes and anthromes. Land-use and land-cover. Urban-rural polarization and interaction.
2.	Environmental view on sustainable urban development	Urban ecosystems. Interactions between human and ecosystem components: environmental impact assessment and ecosystem services. Urban climate: meso-climatic anomalies and resilience to climate change. Air quality in cities: pollution and protection. National and international regulations on air quality. Water

		management in cities. Principles of urban hydrology. Urban green infrastructure: tree condition, health, stability and ecosystem services. Urban soils: soil-forming factors, properties, functions and services. Best management practices for urban soils. Modeling and design of artificial urban soils' constructions. Biodiversity in urban context. Urban soundscapes. Principles of acoustic ecology. Types of sounds: Lo-fi and Hi-fi soundscapes. Sound and noise. Noise generators. Acoustic design and noise maps. Monitoring and management of urban green infrastructures and soils. Smart technologies for express- and integral monitoring.
3.	Social-economic perspectives of sustainable urban development	Ecosystem services: history of development and current implementation of the concepts. Millennium Ecosystem Assessment, The Economy and Ecology of Biodiversity, Ecosystem Services Partnership. Linking properties, functions, services and decision-makers. Urban ecosystem services. Human wellbeing. Equality and inequality: political, economic and social concepts. Quality of life in cities. Recreational, social and cultural services in cities. Nature-based solutions. Sustainable food production in cities. Urban farming: environmental, social and economic challenges and perspectives. Education for sustainable urban development.

## 5.2 Sections of disciplines and types of classes

№	The name of the discipline section	Lect	Practicals and labs			IW	C	Total
			P/S	L	Online format			
1	Urbanization and sustainable development	6	7		2	28	2	43
2	Environmental view on sustainable urban development	10	20		10	28	2	60
3	Social-economic perspectives of sustainable urban development	8	22		10	44	3	77

## 6. Lab practical

Not included.

## 7. Practical classes (seminars)

No	Discipline section number	Subjects of practical training (seminars)	Labor capacity (hour.)
1.	1	What is sustainable development? A literature review and synthesis.	2
2.	1	Working with international agreements of sustainable development	2
3.	1	Analyzing and mapping urbanization at multiple scales	3
4.	2	Mapping urban heat island and estimating climate comfort	4
5.	2	Smart technologies to monitor health, safety and stability of urban trees	6
6.	2	Urban soils' quality and health: monitoring and assessment	6
7.	2	Noise mapping and soundscape design	4
8.	3	Classification, identification and assessment of ecosystem services	6
9.	3	Social surveys and interviews to estimate recreational, social and cultural ecosystem services	6
10.	3	Integral approaches to quantify and map ecosystem services for sustainable urban development	10

## 8. Educational and methodical support of discipline:

1. Classrooms equipped with multimedia projectors.
2. Computer labs of the ATI, PFUR Library Information Center with access to the PFUR electronic library system and the Internet.
3. R software (open source software), MS office (Word, Excel, Power Point)

## 9. Information support

### a) Software

- curriculum for the discipline "Sustainable Urban development".
- open source software R.

### b) Databases, reference and search engines

- RUDN Electronic Library System - RUDN EBS: <http://lib.rudn.ru:8080/MegaPro/Web>
- University Library Online: <http://www.biblioclub.ru>
- Iqlib: <http://www.iqlib.ru>
- Science Direct: <http://www.sciencedirect.com>
- EBSCO: <http://search.ebscohost.com>
- Springer/Kluwer: <http://www.springerlink.com>
- Taylor & Francis: <http://www.informaworld.com>
- RUSSIA University Information System: <http://www.cir.ru/index.jsp>

- RUDN educational portal: <http://web-local.rudn.ru/>
- Graduate Student Advisor <http://www.studmedlib.ru>

## 10. Methodological support:

### a) main sources:

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.

### b) supplementary sources:

1. Aspinall R, Staiano M (2017) A Conceptual Model for Land System Dynamics as a Coupled Human–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, Biodiversity and Ecosystem Services: Challenges and Opportunities*. Springer Netherlands, Dordrecht
7. Farina A (2014) *Soundscape Ecology*. Springer Netherlands, Dordrecht
8. 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



9. Frolova M (2019) From the Russian/Soviet landscape concept to the geosystem approach to integrative environmental studies in an international context. *Landsc Ecol* 34:1485–1502 . doi: 10.1007/s10980-018-0751-8
10. 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
11. 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
12. 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
13. 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
14. 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
15. Tello E, Galán E, Sacristán V, Cunfer G, Guzmán GI, González de Molina M, Krausmann F, Gingrich S, Padró 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 Vallès County, Catalonia, c.1860 and 1999). *Ecol Econ* 121:160–174 . doi: 10.1016/j.ecolecon.2015.11.012

## 11 Methodological Guidelines for Students in the Discipline (Module)

The final assessment of the Sustainable Urban Development course is formed on the basis of the final score obtained during the semester.

Post-graduate students are required to attend lectures and seminars, to participate in foreign and current attestations, and to complete the teacher's tasks. While attending classes, postgraduates should be able to take notes of the necessary material. The notes thus prepared will allow the teacher to evaluate the knowledge of the graduate student more objectively.

Active work at the seminar (ability to lead a discussion, creative approach to the analysis of texts, the ability to clearly and concisely formulate their thoughts) and the performance of independent works using the software R.

*Creative work of post-graduate students:*

In the process of learning activities, students have the opportunity to develop their creative abilities, as well as the skills of writing scientific works and presenting them to the audience on their own or with the help of a teacher.

Scientific topic - a small oral (5 minutes) report on the topic of the seminar session, which contains the most current information, illustrated with examples, previously not covered in the lecture course. The student is required to navigate freely in the presented material, to answer the questions of colleagues and the teacher. The scientific message does not require any special design.

Scientific report - oral works, which formulates and covers a certain scientific problem for 15-50 minutes with the presentation of the material in the format of PowerPoint or other means of visualization. A scientific report necessarily implies a speech to the audience, and the content and presentation of the material is equally evaluated. The student is required to freely navigate in the presented material, to answer questions of colleagues and the teacher. The research report does not require a special written form, but in the last slide of the presentation it is necessary to specify the list of sources of information.

*Outside auditorium self-study includes:*

study of the material on the textbook, textbooks on paper and in electronic form; preparation of the abstract on the selected topic; preparation for the performance of control works and test assignments.

For the best assimilation of theoretical information obtained in the framework of this course, the graduate student is invited under the guidance of a supervisor to perform independent research work. This type of activity helps the graduate student to consolidate and expand the scope of knowledge, improve practical skills of working with normative, statistical material and special literature.

In this regard, the student should pay special attention to the choice of the topic of the relevant work. It is recommended to take into account the student's own interest and the planned scope of his or her future activities in the first place. This list will help to guide the graduate student, determine his preferences and, together with the supervisor, formulate the topic more specifically.

The program is drawn up in accordance with the requirements of the PFUR higher educational establishment.

## **12. Assessment tools for interim certification of students in the discipline (module)**

*Materials for assessing the level of mastering of the study material of the discipline "Sustainable Urban Development" (assessment materials), including a list of competencies with an indication of the stages of their formation, a description of indicators and assessment criteria for competencies at various stages of their formation, a description of assessment scales, standard control tasks or other materials necessary to assess knowledge, abilities, skills and (or) activity experience that characterize the stages of competence formation in the development of the educational programme, methodological materials that determine the assessment procedures for knowledge, skills and (or) activity experience, characterizing the stages of competence formation, are developed in full and are available for students on the discipline's TUIS PFUR website.*

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