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

Agrarian-Technological Institute

Approved by ISSU

PROGRAM

Discipline title Modeling and design of urban green infrastructures

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 - to develop an environmental outlook and an introduction to sustainable design theory and practice to address environmental issues in the design and modelling of urban green infrastructure, to form and demonstrate an understanding of the links between natural and anthropogenic systems, and the principles of optimal relationships between them

Tasks:

- to explore, through concrete examples, the relationship between the environmental challenges of stabilizing and improving the parameters of the environment and through green infrastructure facilities;
- to introduce the basics of urban ecology, domestic and world experience in modelling and designing architectural objects taking into account environmental requirements;
- consider design methods for integrated assessment and prediction of the equilibrium state of the urban environment in the design process at different levels.

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

The discipline Modeling and design of urban green infrastructures belongs to the variative 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 following disciplines

№	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 ecosystems

	competence in official-business, educational-professional, scientific, socio-cultural, everyday life spheres of foreign-language communication;		
General professional competencies			
2	GPC-1 ability to independently carry out research activities in the relevant professional area using modern research methods and information and communication technologies		GIS and dynamic modeling in urban environment
Professional competencies			
3	PC-2 be able to diagnose environmental problems, assess the impact of planned facilities or other forms of economic activity and develop practical recommendations for nature conservation and sustainable development PC-3 have the skills to conduct surveys, studies and tests in relation to the objects of urban planning		Modeling urban ecosystems

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 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 competence in official-business, educational-professional, scientific, socio-cultural, everyday life spheres of foreign-language communication;

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

PC-2 be able to diagnose environmental problems, assess the impact of planned facilities or other forms of economic activity and develop practical recommendations for nature conservation and sustainable development

PC-3 have the skills to conduct surveys, studies and tests in relation to the objects of urban planning

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

Know:
- basic theoretical knowledge at the intersection of ecology, architecture and urban planning;
- principles of landscaping and improvement of urban areas;
- current environmental phenomena and acute problems of habitat, settlement and urban development on planetary, regional and local levels;
- norms of creation, maintenance and upkeep of urban green spaces.
- content and focus of modern scientific research in the field of architectural and urban ecology

Be able to:
-conduct monitoring of the condition of green spaces;
- find (determine) the relationship between environmental requirements and architectural solutions.
- carry out assembly and processing of Tree Talker data

Master*:*
- skills in analyzing and assessing different ecological-architectural and architectural situations affecting the development of urban planning and architectural projects;
- methods of using modern technologies for continuous monitoring of the state of green spaces;
- skills in modelling the condition, functions and ecosystem services of green spaces.
- content and methods of pre-project and project ecological researches.

4. The volume of discipline and types of educational work

The discipline covers 2 ECTS.

Type of study		Total hours	Semesters			
				2		
Classroom activities (total)		80				
Including:		-	-	-	-	-
Lectures		40		40		
Practical Activities (PP)		40		40		
Seminars (S)						
Labs (L)						
Individual work (total)		90		90		
Control		10		10		
Total labor time hour	hours	180		180		
	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.	Components of urban green infrastructure	The principles of gardening and improvement of urban areas. Urban flora: species diversity, spatial structure, limiting factors. Trees and bushes in the city. City lawns: types, principles of arrangement and care. Ecological and aesthetic functions of green spaces in the city. Normative standards for the creation, maintenance and care of green spaces in the city.

		Ecosystem services of urban green infrastructure. Green infrastructure and blue infrastructure: a combination of plantings and water bodies in the city. Urban soils and soil structures: properties, functions, formation factors. Urban farming: food, environmental and socio-economic perspectives.
2.	Advance technologies in monitoring, modeling and management of urban green infrastructure	Goals and objectives of monitoring the state of green spaces. Physiological parameters of the state of green spaces. The vertical stability of trees and the risks of windiness. Traditional methods of monitoring the state of green spaces: visual assessment, instrumental methods. Remote sensing methods for assessing the status of green spaces. Vegetation indices. Modern technologies for continuous monitoring of green spaces. Technology Tree Talker. Modeling the status, functions and ecosystem services of green spaces. I-tree model. Decision making software for the sustainable operation of green spaces.

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	Reviewing descriptive statistics	20	20		10	40	10	90
2	Data analysis, modeling and projection	20	20		10	40	10	90
3	Introduction to geostatistical analysis	20	20		10	40	10	90

6. Lab practical

Not included.

7. Practical classes (seminars)

No	Discipline section number	Subjects of practical training (seminars)	Labor capacity (hour.)
1.	1	The principles of gardening and improvement of urban	2

		areas.	
2.	1	Urban flora: species diversity, spatial structure, limiting factors.	2
3.	1	Trees and bushes in the city.	2
4.	1	City lawns: types, principles of arrangement and care.	2
5.	1	Ecological and aesthetic functions of green spaces in the city.	2
6.	1	Normative standards for the creation, maintenance and care of green spaces in the city.	2
7.	1	Ecosystem services of urban green infrastructure.	2
8.	1	Green infrastructure and blue infrastructure: a combination of plantings and water bodies in the city.	2
9.	1	Urban soils and soil structures: properties, functions, formation factors.	2
10.	1	Urban farming: food, environmental and socio-economic perspectives.	2
11.	2	Goals and objectives of monitoring the state of green spaces.	2
12.	2	Physiological parameters of the state of green spaces.	2
13.	2	The vertical stability of trees and the risks of windiness.	2
14.	2	Traditional methods of monitoring the state of green spaces: visual assessment, instrumental methods.	2
15.	2	Remote sensing methods for assessing the status of green spaces.	2
16.	2	Vegetation indices.	2
17.	2	Modern technologies for continuous monitoring of green spaces.	2
18.	2	Technology Tree Talker.	2
19.	2	Modeling the status, functions and ecosystem services of green spaces.	2
20.	2	I-tree model.	2

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.

9. Information support

a) Software

- curriculum for the discipline " Modeling and design of urban green infrastructures ".
- Moscow interactive system of environmental monitoring www.mosecom.ru

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

- Tailor & 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. Architectural bionics (Y.S.Lebedev). – M.: Stroyizdat, 1990 (in Russian)
2. Kurbatova A.S. and others Ecology of the city. – M.: Scientific World, 2004. – Pp.624. (in Russian)
3. Lunsberg G.E. The climate of the city / Translated from English by A.Fertman.- Leningrad: Gidrometeozdat, 1983 (in Russian)
4. Nefedov V.A. Landscape and sustainability of the environment. – Saint-Petersburg.: Poligrafist, 2002. – Pp.295. (in Russian)
5. Tetior A.N. Environmental infrastructure and human environment. – M.: Publishing House RAFIA, 2002. – Pp.421.
6. Tetior A.N. Sustainable urban development. – M.: Committee on Telecommunications and Mass Media of the Government of Moscow, 1999. – Part 1,- Pp.173.
7. Titova N.P. Roof gardens. – M.: OLMA-PRESS Grand, 2002. – Pp.112. (in Russian)

б) supplementary sources:

1. Bandaranayake W., Qian Y. L., Parton W. J., Ojima D. S. and Follett R. F., 2003. Estimation of Soil Organic Carbon Changes in Turfgrass Systems Using the CENTURY Model. Agron. J. 95, 558–563.
2. Dolgikh, A.V., Aleksandrovskii, A.L., 2010. Soils and cultural layers in velikii Novgorod. Eurasian Soil Science, 43, 477–48.
3. Gerasimova, M.I., Stroganova, M.N., Mozharova, N.V., Prokofieva, T.V., 2003. Urban Soils. Oykumena, Smolensk.(in Russian)
4. Golubiewski, N.E., 2006. Urbanization Increases Grassland Carbon Pools: Effects of Landscaping in Colorado's Front Range. Ecological Applications 16, 555-571.
5. Ilina, I.N. (Eds.), 2000. Environmental atlas of the Moscow city. ABF. Moscow (in Russian)
6. Jo, H.K., McPherson E.G., 1995. Carbon Storage and Flux in Urban Residential Greenspace. Journal of Environmental Management 45, 109–133.
7. Kaye, J.P., McCulley, R.L., Burkez, I.C., 2005. Carbon fluxes, nitrogen cycling, and soil microbial communities in adjacent urban, native and agricultural ecosystems. Global Change Biology 11, 575-587.
8. Lapin, Y.N. Ecological housing - key to the future. – M.: 1998. – Pp.160;
9. Lorenz, K., Lal, R., 2009. Biogeochemical C and N cycles in urban soils. Environment International 35, 1–8.
10. Nefedov V.A. Landscape and sustainability of the environment. – Saint-Petersburg.: Poligrafist, 2002. – Pp.295. (in Russian)
11. Nefedov V.A. Urban Landscape Design / Nefedov V.A.:. – Saint-Petersburg.: "Liubavich", 2012. – Pp.320. (in Russian)
12. Pickett, S.T.A., Cadenasso, M.L., Grove, J.M., Boone, C.G., Groffman, P.M., Irwin, E., Kaushal, S.S., Marshall, V., McGrath, B.P., Nilon, C.H., Pouyat, R.V., Szlavecz, K., Troy,

A., Warren, P., 2011. Urban ecological systems: scientific foundations and a decade of progress. Journal of Environmental Management 92, 331–362
13. Prokofieva, T.V., Stroganova, M.N., 2004. Soils of Moscow city (soils in urban environment, their specifics and environmental significance). Moscow Biological. GEOS, Moscow.
14. Romzaykina, O.N., Vasenev, V.I., Khakimova, R.R., Hajiaghayeva, R., Stoorvogel, J.J., Dovletyarova, E.A. 2017. Spatial variability of soil properties in the urban park before and after reconstruction. Soil and Environment, 36 (2), pp. 155-165.
15. Scalenghe, R., Marsan, F.A. The anthropogenic sealing of soil in urban areas, 2009. Landscape and urban planning 90, 1-10. .
16. Tetior, A.N. Ecocity: Problems and Solutions / Scientific-methodical literature for engineers, scientists, graduate students to architecture and construction, workers prefectures. – M., 2005. – Pp.308.
17. V.I. Vasenev, A.V. Smagin, N.D. Ananyeva, K.V. Ivashchenko, E.G. Gavrilenko, T.V. Prokofeva, A. Patlseva, J.J. Stoorvogel, D.D. Gosse and R. Valentini.2017. Urban Soil's Functions: Monitoring Assessment and Management. Pages 359-409 in A. Rakshit et al. (eds.), Adaptive Soil Management: From Theory to Practices, Springer Nature Singapore
18. V.I. Vasenev, J.J. Stoorvogel, R. Leemans, R. Valentini, R.A. Hajiaghayeva. 2018. Projection of urban expansion and related changes in soil carbon stocks in the Moscow Region. Journal of Cleaner Production 170, 902-914.
19. Vasenev, V.I., Ananyeva, N.D., Makarov, O.A., 2012. Specific features of the ecological functioning of urban soils in Moscow and Moscow oblast. Eurasian Soil Science 45, 194-205.
20. Vrscaj, B., Poggio, L., Marsan, F., 2008. A method for soil environmental quality evaluation for management and planning in urban areas. Landscape and Urban Planning 88, 81-94

11 Methodological Guidelines for Students in the Discipline (Module)

The final grade for the course "Modeling and Design of Urban Green Infrastructure" is formed on the basis of the final grade obtained during the semester. Graduate students are required to attend classes, complete the assignments of the teacher of the discipline, familiarise themselves with the recommended literature, etc. During the attestation of the student the quality of work in the classes, the level of preparation for independent activity in the chosen field, the quality of performance of the tasks of the teacher of the discipline, the ability to independently study the training material is assessed.

At seminars and lectures in classrooms, the relevant topics are discussed using multimedia equipment (computer, projector). Independent work during extracurricular hours can also take place in the classrooms of the department and the computer lab, where students can study the material by presentations prepared by the teachers of the department. Presentations on the topics of classes can be recorded on a CD or a flash card for independent work of postgraduate students on a home computer.

Electronic tutorials on a number of studied topics are available on the department and department staff pages on the PFUR educational portal, as well as on local resources of the PFUR electronic library system. One of the forms of independent work is individual assignments in Quantum GIS, which has been mastered during the course.

Extracurricular independent work includes:

study of the materials recommended by the teacher for use, preparation for assignments at the seminars using PCs and QGIS software; preparation for tests on each of the specified sections of the discipline.

Postgraduate knowledge control is carried out by the teacher, leading the discipline "Modeling and Design of Urban Green Infrastructure". Current knowledge control is carried out in the course of lectures and seminars (practical) classes. During the seminar (practical class) a postgraduate student should present the work done during the seminar (practical class), describe the algorithm of his/her actions, be able to answer the questions of the teacher. This type of work is aimed at solving the following pedagogical tasks: 1) stimulating independent work of postgraduate students; 2) monitoring the degree of mastering of the training material by postgraduates; 3) identifying problematic aspects and topics that require special attention and concentration. The follow-up control is carried out in the form of a midterm and ongoing assessment in the form of a test.

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 "*Modeling and Design of Urban Green Infrastructure*" (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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