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

Agrarian-Technological Institute

Approved by ISSU

PROGRAM

Discipline title Research planning

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 provide postgraduate students with a theoretical understanding and practical skills in planning experiments, collecting, processing and analyzing research data, and presenting and interpreting results

Tasks:

- to master the structure of research work;
- to learn how to plan and set up a scientific experiment;
- to learn the terminology and basic concepts that are used in modern earth sciences;
- to learn the methodology of collecting, analyzing information, interpreting research results;
- to master the technology of visualization of scientific work results, to be able to make graphs, tables, drawings, maps, cartograms, charts, create presentations;
- to master modern methods of search and analysis of scientific information, be able to use basic knowledge bases;
- to get skills of writing independent scientific works: theses of scientific conferences, scientific publications, monographs

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

The discipline Research planning 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-3 Willingness to participate in Russian and international research teams to solve scientific and research-educational problems UC-4 readiness to use modern methods and technologies of scientific communication in national and foreign		Advanced Statistics

	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; UC-5 capability to plan and meet the challenges of their own professional and personal development		
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		Advanced Statistics
Professional competencies			
3	PC-1 Have an up-to-date knowledge of the scientific subject area in the programme area and be able to use it for scientific, practical and pedagogical purposes PC-3 be able to analyze and assess the impact of the environment on human health and livelihoods PC-6 ability to organize and manage scientific research, research and production, expert analytical work and teaching using in-depth knowledge in the field of training		Advanced Statistics

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-3 Willingness to participate in Russian and international research teams to solve scientific and research-educational problems

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;

UC-5 capability to plan and meet the challenges of their own professional and personal development

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

PC-1 Have an up-to-date knowledge of the scientific subject area in the programme area and be able to use it for scientific, practical and pedagogical purposes

PC-3 be able to analyze and assess the impact of the environment on human health and livelihoods

PC-6 ability to organize and manage scientific research, research and production, expert analytical work and teaching using in-depth knowledge in the field of training

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

Know:

- Methods of planning and conducting research, collecting and interpreting the data obtained and presenting the research results;

- principles of primary statistical processing of experimental data;

- Main sources of scientific information, principles of scientific bibliography and scientometrics;

- sources of funding for scientific work and principles of preparing applications for scientific grants.

To be able to:

- set a scientific problem, plan a scientific research;

- work with sources of special literature;

- manage a research project.

To be able to: -methods of scientific cognition:

-methods of scientific cognition, methods of discussion, polemics, dialogue

- theory of statistical methods of analysis

- practical skills of statistical data analysis

4. The volume of discipline and types of educational work

The discipline covers 2 ECTS.

Type of study		Total hours	Semesters			
			1			
Classroom activities (total)		38	38			
Including:		-	-	-	-	-
Lectures		10	10			
Practical Activities (PP)		28	28			
Seminars (S)						
Labs (L)						
Individual work (total)		30	30			
Control		4	4			
Total labor time hour	hours	72	72			
	ECTS	2	2			

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.	Introduction to research	Methodology of scientific research. Key features of science: specific research object, original scientific problematic, research methodology. Special methods. General methods. Scientific method. Discussion on the best method. Principles of the scientific methodology. Conformity principle. Subsidiarity principle. Verification principle. Reduction principle. Integrity principle. Modeling principle and analogy method. General scientific approaches. Methods of empirical research. Methods of theoretical research. Methods of integral logics. Observation. Experiment. Types of the experiment. Comparison. Description. Measurement. Formalization. Axiom method. Hypothetic-deductive method. Analysis. Synthesis. Abstraction. Idealization. Induction. Deduction. Analogy. Modeling. System approach. Structural-functional approach. Probabilistic and statistical approaches.
2.	Research planning and experimental set-up	Types of scientific publications. Types of journals. How to evaluate the journal's quality. Search/ citation database (Scopus, Web of Science, Google Scholar). Impact factor. Problems in IF robustness. How to evaluate the author's quality. H (Hirsch) index. Algorithm of scientific reading. Hypothesis testing. Hypothesis testing framework. Null hypothesis. Alternative

		hypothesis. Testing hypothesis. Decision errors. Type 1 Error. Type 2 Error. Significance level. P-value.
3.	Interpretation and visualization of research results	Scatter plot. Examining a numerical variable. Sample. Population. Mean. Geometrical mean. Harmonic mean. Weighted mean. Visualization of different types of data. Categorical ordinal: bar plots, diagrams. Categorical regular: bar plots, graphs, tables. Numerical discrete: maps, diagrams. Numerical continuous: graphs, histograms. Mode. How to build a histogram? Parameters of a histogram. Estimates. Fractile (quantile). Calculating fractiles. Median. Estimating median. Mean and median. Skewed distribution. Exploring variability. Quartiles and range. Estimating variability. Deviation. Variance. Coefficient of variance. Boxplots.
4.	Scientific writing skills	Universal structure of the scientific publication. Universal components of the scientific publication. Title. Authors listing. Abstract. Brief (around 150 words) summary of the problem, the methods, the results and the conclusions. Key words. Introduction: background explaining the problem, reasons for conducting the research. Relevant (available) research to provide the context of the paper. References. Materials and methods. Research area. Study plot. Field methods (sampling, sample preparation, in situ measurements). Laboratory methods (chemical, physical, biological analysis etc). Statistical and analytical methods (evaluation, statistics). Results: figures, tables, descriptions. Discussion. Conclusions.
5.	Scientific fundraising	Structure of scientific funding. Budgetary (public) funding. Private funding. Sources of funding for research. Governmental grants for fundamental research. Governmental grants for applied research. Grants for mobility. Grants from private foundations. Russian Foundation for Fundamental Research (RFFR). Russian Scientific Foundation (RSF). Russian target program(RTP). Horizon 2020 (H2020). Megagrant of the RF government. Fellowships/ grant of the RF President Foundation (Russia). Marie Sklodowska-Curie Foundation. Humboldt foundation. European research council starting grant. Foundation to support innovative business

		start-ups (FASIE). Funding structure. National, regional and municipal foundations to support small scale-enterprises in innovative sphere. Grants and contests of federal, regional and local ministries and departments (for example, the department of research, industry and business of Moscow). Erasmus+. Fulbright foundations. DAAD foundation. Jean Monnet programs. COST actions. Potanin foundations. World bank projects. Crowd-funding platforms.

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	Introduction to research	2	4		2	2	2	10
2	Research planning and experimental set-up	2	6		2	6	2	16
3	Interpretation and visualization of research results	2	6		2	6	2	16
4	Scientific writing skills	2	6		2	6	2	16
5	Scientific fundraising	2	6		2	4	2	14

6. Lab practical

Not included.

7. Practical classes (seminars)

No	Discipline section number	Subjects of practical training (seminars)	Labor capacity (hour.)
1.	1	Title, Introduction, State-of-the-Art, Objectives, Hypotheses (Critical discussion of the examples)	6
2.	2	Uncertainties of experimental design (Critical discussion of the examples); Development the research strategy, design of the experiments (sites selection, sampling procedure, selection of methods) of own projects	6
3.	3	Presentation and critical discussion of Topics, Tasks and Summary of own Projects	6
4.	4	Project Summary (Critical discussion of the examples). Written Summary of own Project – discussion and improvements	6
5.	5	Comparisons of requirements of National and International Scientific Foundations	4

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
- 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. D. M. Diez, C.D. Barr, M. Cetinkaya-Rundel. OpenIntro Statistics. 2014. openintro.org
2. J. Leek. The elements of data analytic style. http://leanpub.com/datastyle
3. Dmitriev E.A. Mathematical statistics in soil science. MSU edition. 1995.
4. R. Lyman Ott & Michael Longnecker. An introduction to statistical methods and data analysis. 6th edition
5. Hans-Peter Pifo. Statistics for bachelors in Agriculture and Renewable Energy sources. Hochenheim. 288 P.
6. Joshua Schimel Writing Science. Oxford University Press

б) supplementary sources:

1. Aller L., T. Bennett, J. H. Lehr, R. J. Petty, and G. Hackett. 1987. DRASTIC: A standardized system for evaluating ground water pollution potential using hydrogeological settings. EPA/600/2-87/035. Washington, D.C.: Environmental Agency.
2. ArcGis 9. Что такое ArcGis? Официальное руководство ESRI. США. 2004.-127 с.
3. Bailey, T. C., and A. C. Gatrell. 1995. Interactive spatial data analysis. Harlow, UK: Longman.
4. Batty, M. J. 1997. The computable city. International Planning Studies 2: 155–73.
5. Batty, M. J., and P. A. Longley. 1994. Fractal cities: A geometry of form anfunction. San Diego, Calif.: Academic Press.

6. Benenson, I. 2004. Agent-based modeling: From individual residential to urban residential dynamics. In Spatially integrated social science, ed. M. Goodchild and D. J. Janelle, 67–94. New York: Oxford University Press.
7. Berger T. Agent-based spatial models applied to agriculture: a simulation tool for technology diffusion, resource use changes and policy analysis. 2001. Agricultural Economics. # 25. P. 245–260.
8. Carey, G. F., ed. 1995. Finite element modeling of environmental problems: Surface and subsurface flow and transport. New York: John Wiley and Sons.
9. Crosier, S. J., M. F. Goodchild, L. L. Hill, and T. R. Smith. 2003. Developing an infrastructure for sharing environmental models. Environment and Planning B: Planning and Design 30: 487–501.
10. Dibble, C., and P. G. Feldman. 2004. The GeoGraph 3D Computational Laboratory: network and terrain landscapes for RePast. Journal of Artificial Societies and Social Simulation 7(1). Available: jasss.soc.surrey.ac.uk/ 7/1/7.html.
11. Engelen G., White R., De Nij T. Environment Explorer: Spatial Support System for the Integrated Assessment of Socio-Economic and Environmental Policies in the Netherlands. 2003. Integrated Assessment. V. 4, #. 2. P. 97–105.
12. Fotheringham, A. S., and M. E. O'Kelly. 1989. Spatial interaction models: Formulations and applications. Boston: Kluwer.
13. Goodchild M.F. GIS and modeling overview. In: GIS, Spatial Analysis and Modeling. Maguire D.J. , Batty M., Goodchild M.F. (Eds). ESRI Press, Redlands. P. 2-17.
14. Goodchild, M. F., and J. Proctor. 1997. Scale in a digital geographic world. Geographical and Environmental Modeling 1: 5–23.
15. Goodchild, M. F., B. O. Parks, and L. J. Steyaert. 1993. Environmental modeling with GIS. New York: Oxford University Press.
16. Haining, R. P. 2003. Spatial data analysis: Theory and practice. New York: Cambridge University Press.
17. Langran, G. 1993. Time in geographic information systems. London: Taylor and Francis.McHarg, I. L. 1969. Design with nature. Garden City, N.Y.: Natural History Press.
18. Modeling the Spatial Dynamics of Regional Land-Use: The CLUE-S Model Environmental Management V. 30, # 3, P. 391–405.
19. O'Sullivan, D., and D. J. Unwin. 2003. Geographic information analysis. New York: John Wiley and Sons.
20. Peuquet, D. 2002. Representations of space and time. New York: Guilford.
21. Tomlin, C. D. 1990. Geographic information systems and cartographic modeling. Englewood Cliffs, N.J.: Prentice Hall.
22. Worboys, M. F., and M. Duckham. 2004. GIS: A computing perspective. New York: Taylor and Francis.
23. Zeiler, M. 1999. Modeling our world: The ESRI guide to geodatabase design. Redlands, Calif.: ESRI Press

11 Methodological Guidelines for Students in the Discipline (Module)

The final grade for the Research Planning course is formed on the basis of the final grade obtained during the semester. The course is based on mastering the principles of research planning based on critical analysis of existing research projects and development of own research project within the framework of scientific problems of postgraduate programme.

Graduate students are required to attend classes, fulfil the assignments of the lecturer of the discipline, read the recommended literature, etc. During the certification of the student is assessed the quality of work in class, the level of preparation for independent activities 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. Lectures and practical classes are focused on helping the postgraduate student to plan and write an independent research project that meets the requirements for

submission to Russian and international scientific foundations (for example, the project "My first grant" in the Russian Foundation for Basic Research). Presentation and defence of an independent project is a form of final attestation on the discipline.
At the seminars and lectures in the classrooms there is a review of the relevant topics using multimedia equipment (computer, projector).Independent work in out-of-classroom hours can also take place in the classrooms of the department and computer class, where students can study the material on presentations prepared by teachers of the department.
Electronic tutorials on a number of topics can be found on the Department and its staff pages on the PFUR educational portal, as well as on the local resources of the PFUR electronic library system.
Extracurricular independent work includes:
studying materials recommended by the lecturer for use, preparing for seminar assignments, in particular, searching and working with scientific sources, parsing and critically analyzing existing research projects, collecting and processing data for independent research projects.
Postgraduate student's knowledge control is carried out by the teacher, who leads the discipline "Research Planning". Current knowledge control is carried out during lectures and seminars (practical classes). During the seminar (practical exercises) the postgraduate student must present the work performed during the seminar (practical exercises), describe the algorithm of their 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 "Research Planning" (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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