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**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

METHODOLOGY OF SCIENTIFIC CREATION

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

1. COURSE GOAL(s)

The course is designed to provide knowledge on the basic methods of scientific creativity, to gain the use of existing techniques, methods and skills of observation, experimentation and processing of results, in accordance with the material and technical base and regulatory documents that exist on this topic.

• 2. REQUIREMENTS FOR LEARNING OUTCOMES

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

Competence code	Competence descriptor	Competence formation indicators
GC-6	Able to identify and implement the priorities of their own activities and ways to improve it based on self-assessment	GC-6.1 can evaluate resources and their limits (personal, situational, temporary), use them appropriately
		GC-6.2 capable to determine educational needs and ways to improve their own (including professional) activities based on self-assessment
		GC-6.3 owns skills in the flexible professional trajectory building, taking into account the accumulated experience of professional activity, dynamically changing labor market requirements and personal development strategies
GPC-1	Able to use philosophical concepts and methodology of scientific creation on the various levels of matter, space and time study	GPC-1.1 knows the philosophical concepts of natural science and methodology of scientific creation
		GPC-1.2 able to use in-depth knowledge in the philosophical concepts of natural science in assessing the professional activities consequences
		GPC-1.3 able to apply the acquired knowledge in the research activities, to make correct generalizations and conclusions
GPC-6	Able to design, represent, protect and disseminate the results of the professional activities, including research	GPC-6.1 able to receive, analyze, summarize the necessary scientific information using modern research methods, present their own results in the form of scientific articles and public speeches
		GPC-6.2 owns the skills of oral report and presentation with regards to the project and scientific activities results
		GPC-6.3 knows methodological foundations of scientific research, copyright and scientific ethics requirements

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

Course *Methodology of Scientific Creation* refers to the **University Disciplines Module** 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*
GC-6	Able to identify and implement the priorities of their own activities and ways to improve it based on self-assessment	No	Scientific research work Climate Project Development
GPC-1	Able to use philosophical concepts and methodology of scientific creation on the various levels of matter, space and time study	no	State Exam Master's Thesis Defence
GPC 6	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	Climate Neutrality and Waste Management

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
<i>Contact academic hours</i>					
Lectures	17	17			
Lab works					
Seminars (workshops/tutorials)	17	34			
<i>Self-study</i>	83	66			
<i>Evaluation and assessment (exam; pass/fail grading)</i>	27	27			
The total course workload	hours	144	144		
	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. Scientific research methods, their development in ecology	Topic 1.1. Basic terms and definitions, structure of research activities, relevance and scientific novelty, classification of scientific research methods,	L, S
	Topic 1.2. Tools for identifying problems, methods aimed at enhancing the use of experience and intuition of specialists, logical laws	L, S
Module 2.	Topic 2.1. Information, types of information, ascending/descending information flows, the birth of information, the law of information dispersion	L, S

Title of Course Modules	Content	Types of academic activities
Introduction to Information Retrieval Theory	Topic 2.2. Search for information, search for information in the Internet, use of libraries and databases	L, S
Module 3. Empirical methods of knowledge	Topic 3.1. Methods of empirical knowledge, observation	L, S
	Topic 3.2. Measurements, measurement scales, measurement errors	L, S
	Topic 3.3. The concept of an experiment, experiment planning, processing of experimental results	
	Topic 3.4 Surveys, interviews, expert surveys	L, S
Module 4 Methods and approaches to the analysis of the obtained data	Topic 4.1 Statistical and mathematical methods in ecology. Reliability and validity of the obtained data. Topic 4.2. Experiment, approaches to analysis. Collection and analysis of databases	L, S
Module 5 Presentation of scientific data	Topic 5.1 General requirements for research work, the basics of scientific citation, the effectiveness of scientific research	L, S
	Topic 5.2 The concept of plagiarism in scientific activity	L, S
	Topic 5.3 Discoveries, their mechanism and typology	L, S
Module 6 Final qualifying works	Topic 6.1 Thesis planning. Responsibilities of the head of the thesis. Structure and design of the thesis	L, S
	Topic 6.2 Approaches to presenting thesis data	L, S
	Topic 6.3 Presentation of the work	L, S
Module 7 Research Article	Topic 7.1 Types of scientific articles. Types and ratings of journals.	L, S
	Topic 7.2 Citation index	L, S
	Topic 7.3 Article writing approaches	L, S
Module 8 Conferences, symposiums, etc	Topic 8.1 Types of scientific events. Purposes of participation in conferences, etc. Presentation of materials. Scientific discussion and its importance in promoting research, conducting scientific discussion	L, S
Module 9 Financial support for research	Topic 9.1 Grants. Funds. Paid scientific activity within the framework of contracts. Grant application, execution and planning.	L, S
Module 10 Ethical aspects of scientific research in ecology	Topic 10.1 Ethical code of the ecologist. Rules of biological ethics in scientific research.	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.
Seminars	Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable multimedia projector, laptop, projection screen, stable wireless	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
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. Mishra, Priyadarshini & Dalabehera, Stiti. (2022). Research Methodology:A Practical approach for beginners.
2. C. George Thomas Research Methodology and Scientific Writing Second Edition, Kerala Agricultural University, Thrissur, Kerala, India ISBN 978-3-030-64864-0 ISBN 978-3030-64865-7 (eBook)m 2021 <https://doi.org/10.1007/978-3-030-64865-7>
3. H.C. Joshi. Research Methodology for Environmental Studies Department of Forestry and Environmental Science School of Earth and Environmental Science Uttarakhand Open University Haldwani, Nainital (U.K.), 2022, 305 p

Additional reading:

1. Gauch, H.G. (2003). Scientific method in practice. Cambridge University Press, UK.
2. Insight Media. (2010). How to Read and Understand a Research Study; Research Design: The Experiment; Research Design: The Survey; Research Ethics. DVDs of Science. Insight Media, New York, US.
3. National Academy of Sciences (U.S.). Committee on the Conduct of Science, National Academy of Engineering (1995). On being a scientist: responsible conduct in research. National Academies Press, Washington DC.
4. Wilson, E.B. (1991). An introduction to scientific research. McGraw-Hill, New York.

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/](https://www.yandex.ru/)
- Google search engine <https://www.google.ru/>
- abstract database SCOPUS [http:// www .elsevierscience.ru/ products / 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

Position

Kapralova D.O.

Name, Surname

Signature

HEAD OF DEPARTMENT:

Director of EM Department

Position

Kucher D.E.

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HEAD OF PROGRAMME:

Director of ES&PQM Department

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Savenkova E.V.

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**Federal State Autonomous Educational Institution for Higher Education
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Institute of Environmental Engineering

ASSESSMENT TOOLKIT

METHODOLOGY OF SCIENTIFIC CREATION

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 Project Management

Passport to Assessment Toolkit for Course Methodology of Scientific Creation

Education Field / Speciality 05.04.06 "Ecology and nature management"/ «Climate Project Management»

Course: Methodology of Scientific Creation

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-fail assessment		
			Quiz	Test	Report	Lecture activity	Homework	Article			
GC-6 GPC-1 GPC-6	Scientific research methods, their development in ecology.	Basic terms and definitions, structure of research activities, relevance and scientific novelty, classification of scientific research methods, tools for identifying problems, methods aimed at enhancing the use of experience and intuition of specialists, logical laws.	1	2		1	5		2	11	11
GC-6 GPC-1 GPC-6	Introduction to Information Retrieval Theory	Information, types of information, ascending/descending information flows, the birth of information, the law of information dispersion.	1	2		1	3		1	8	8

		Search for information, search for information in the Internet, use of libraries and databases.									
	Empirical methods of knowledge	Methods of empirical knowledge, observation	1	2	5	1	3		2	14	14
		Measurements, measurement scales, measurement errors									
		The concept of an experiment, experiment planning, processing of experimental results									
		Surveys, interviews, expert surveys									
	Methods and approaches to the analysis of the obtained data	Statistical and mathematical methods in ecology. Reliability and validity of the obtained data. Experiment, approaches to analysis. Collection and analysis of databases.	1	2		1	4		2	10	10
GC-6 GPC-1 GPC-6	Presentation of scientific data	General requirements for research work, the basics of scientific citation, the effectiveness of scientific research	2	2		1			1	6	6
		The concept of plagiarism in scientific activity									
		Discoveries, their mechanism and typology.									
		Thesis planning. Responsibilities of the head of	2	2		1			1	6	6

	Final qualifying works	the thesis. Structure and design of the thesis.									
		Approaches to presenting thesis data									
		Presentation of the work.									
	Research Article	Types of scientific articles. Types and ratings of journals.	2	1		1		15	1	20	20
		Citation index.									
		Article writing approaches									
	Conferences, symposiums, etc.	Types of scientific events. Purposes of participation in conferences, etc. Presentation of materials. Scientific discussion and its importance in promoting research, conducting scientific discussion.	2	2		1			1	6	6
	Financial support for research	Grants. Funds. Paid scientific activity within the framework of contracts. Grant application, execution and planning.	2	2		1			1	6	6
	Ethical aspects of scientific research in ecology	Ethical code of the ecologist. Rules of biological ethics in scientific research.	2	2	5	1			2	12	12
			15	20	10	10	15	15	15		100

Course Methodology of Scientific Creation

QUESTION CARD No 1

QUESTION 1. Explain the concepts of “intuition” and “logic”.

QUESTION 2. Explanation, understanding and interpretation in the natural sciences and humanities. Ethics of science.

3 *

Developer _____ (Kapralova Daria)
signature

Head of Educational Department _____ (Kutcher Dmitry)
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) Define the concept of “scientific creativity”.
- 2) What is the peculiarity of technical creativity and invention?
- 3) Explain the concepts of “knowledge” and “information”.
- 4) How do you understand the terms “relative knowledge”, “absolute knowledge”?
- 5) What is the difference between sensory and rational knowledge?
- 6) What objects of the surrounding world does a person know indirectly?
- 7) Explain the path of the process of knowledge from a scientific idea to a law or theory.
- 8) What is law? theory? 9
- 9) Explain the concepts of “axiom”, “postulate”, “principle”.
- 10) How do analysis and synthesis relate in cognition?
- 11) What are induction and deduction?
- 12) What is characteristic of an analogy?
- 13) What are the advantages of the modeling method?
- 14) How are observation and scientific experiment related in cognition?
- 15) Explain the concepts of “intuition” and “logic”.
- 16) Features of mathematical modeling.
- 17) Science as a cognitive activity, a system of knowledge, a social institution and a special sphere of culture.
- 18) Subject and object of scientific research.
- 19) Object and subject of research, choice of topic, drawing up plans, stages of work on a scientific topic.
- 20) Methods for writing an abstract, dissertation, scientific article, dissertation.
- 21) Editing and reviewing scientific works.
- 22) Information support for the scientific work of a specialist
- 23) Diversity of forms of knowledge. The science.
- 24) Methods of empirical scientific research.
- 25) Methods of theoretical scientific research.
- 26) Methods of theoretical knowledge.

- 27) Basic methods for constructing scientific theories.
- 28) Dynamics of scientific knowledge, growth models.
- 29) The problem of truth in science.
- 30) Explanation, understanding and interpretation in the natural sciences and humanities. Ethics of science.
- 31) Ancient science.
- 32) The concept of the development of science by K. Popper.
- 33) Name the research method and explain your conclusion (formalization, analysis and synthesis, induction and deduction, analogy, etc.).
- 34) On what basic philosophical principles is scientific activity based? Think over the structure of UFO observations, determine the scale of measurements, the stock of measuring instruments, conceptual means of observation, means of recording observations.
- 35) Can an observation be wrong? Why. Explain.
- 36) Why is it necessary to plan an experiment carefully and in advance? 3
- 7) What does the Law of Information Dispersion say (in your own words)? How can this be applied in practice?
- 38) What is the difference between relevance and relevance (in your own words)?
- 39) What is the basic principle of the traditional classification of inventive methods?
- 40) What is the difference between the approach and TRIZ?
- 41) Can survey methods (questionnaires or interviews) be used in the natural sciences?
- 42) What is sampling? Why should we use different types of samples?
- 43) Can we completely avoid measurement/experimental errors?
- 44) What are the basic principles for assessing the value of scientific work.
- 45) What is metrology?

Tentative list of assessment tools

No	Assessment tool	Brief features	Assessment tool representation in the kit
<i>Class work</i>			
1	Survey/Quiz	A tool of control, organised 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 standardised tasks that allows the teacher to automate the procedure for measuring the student's level of knowledge and skills	Tests bank
3	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
4	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.
5	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
6.	Presentation (defence) of project/report/ Library research paper /briefs *	A tool for monitoring the students' ability to present the work results to the audience.	Themes for projects/reports/ Library research paper/ briefs
7	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
8	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	Examples of tasks/questions/exam question cards

		thinking, ability to synthesise the acquired knowledge and apply it to solve practice tasks.	
9	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
10	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
<i>Self- studies</i>			
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	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
5	Standard calculations	A tool to test skills in applying the acquired knowledge, according to a predetermined methodology, solving tasks or fulfilling	Set of tasks for standard calculations

		assignments for a module or discipline as a whole.	
6	Homework	<p>The tasks and assignments differ in terms of the following levels:</p> <p>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,</p> <p>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,</p> <p>c) creative level allows the teacher to evaluate and diagnose students' skills to integrate knowledge of various fields, argue their own point of view.</p>	Set of multi-level tasks and assignments with varying difficulty

Department of Environmental Management

Set of assignments for control work

for the course Methodology of Scientific Creation

What are the types of scientific publications (articles)?

- 1) Original Research
- 2) Short reports or Letters
- 3) Review Articles
- 4) Case Studies
- 5) Methodologies or Methods
- 6) All variants are correct
- 7) There is no correct answer

What is life cycle assessment?

- 1) methodology for assessing environmental impacts associated with all the stages of the life cycle of a commercial product, process, or service
- 2) a set of measures carried out to identify the degree of danger of the impact of economic activities on the environment and public health
- 3) independent assessment of compliance by a business entity and other activities with regulatory requirements in the field of environmental protection and preparation of recommendations in the field of environmental activities

Name the method Sherlock Holmes used “How, in the name of good-fortune, did you know all that, Mr. Holmes?” he asked. “How did you know, for example, that I did manual labour. It’s as true as gospel, for I began as a ship’s carpenter.” “Your hands, my dear sir. Your right hand is quite a size larger than your left. You have worked with it, and the muscles are more developed.”

- 1) induction
- 2) deduction
- 3) analysis
- 4) synthesis

Can we use Wikipedia when creation the scientific article?

- 1) yes
- 2) no
- 3) only for starting the literature review

Sensitive questions in the survey should be

- 1) in the beginning of the survey
- 2) in the middle of the survey
- 3) at the end of the survey
- 4) we could not ask them

What is the difference between the goal of the research and its tasks?

- 1) The goal is the main result of the research, the task is a step to reach it
- 2) The task is the main result of the research, the goal is a step to reach it

Assessment criteria:

(in compliance with the legal regulations in force)

Department of Environmental Management

List of themes for round tables, discussions, polemics, disputes, debates

for the course Methodology of Scientific Creation

- 1) Name the research method and explain your conclusion (formalization, analysis and synthesis, induction and deduction, analogy, etc.)
- 2) Come up with the purpose of the study, the main objectives and the relevance of this study on the situation from the fairy tale about Cinderella.
- 3) On what basic philosophical principles is scientific activity based?
- 4) Think over the structure of UFO observations, determine the scale of measurements, funds of measuring instruments, conceptual means of observation, means of fixing observations.
- 5) Can an observation be wrong? Why. Explain.
- 6) Why is it necessary to carefully and in advance plan the experiment?
- 7) What does the Law of Information Dispersion say (in your own words)? How can it be applied in practice?
- 8) What is the difference between pertinence and relevance (in your own words)?
- 9) What is the main principle of the traditional classification of invention methods? What is the difference between the approach and TRIZ?
- 10) Is it possible to apply survey methods (questionnaires or interviews) in the natural sciences?
- 11) What is a sample? Why should we use different sample types?
- 12) Can we completely avoid measurement/experimental errors?
- 13) What are the basic principles for assessing the value of scientific work.
- 14) What is metrology?

Assessment criteria:

(in compliance with the legal regulations in force)

Developer _____ (Kapralova D.O.)
signature

day, month, year

DEVELOPER:

Associate Professor of the EM
Department

Position

Signature

Kapralova D.O.

Name, Surname

HEAD OF DEPARTMENT:

Director of EM Department

Position

Signature

Kucher D.E.

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HEAD OF PROGRAMME:

Director of ES&PQM Department

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Name, Surname