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ФИО: Ястребов Олег Александрович  
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**Federal State Autonomous Educational Institution for Higher Education  
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA (RUDN University)  
named after Patrice Lumumba  
Institute of Environmental Engineering**

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## **COURSE SYLLABUS**

### **IT in Ecology and Natural Resources Management**

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**Recommended by the Didactic Council for the Education Field for the specialization:**  
05.04.06 "Ecology and Nature Management"

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

«Integrated Solid Waste Management»  
(Network program with L.N. Gumilyov Eurasian National University)

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## 1. COURSE GOAL(s)

The course is designed to help students to obtain the use of computer technologies for searching and processing data arrays in scientific and practical socio-economic and environmental research, as well as in the practical work of an ecologist. The focus is on the use of Excel for this purpose

## 2. REQUIREMENTS FOR COURSE OUTCOMES

The course implementation is aimed at the development of the following competences:

**Table 2.1**

*The list of competences*

Cipher	Competence	Competence achievement indicators (within this discipline)
GC-2 .	Able to manage a project at all stages of its life cycle.	GC-2.1 can formulate a project task based on the problem posed and a way to solve it
		GC-2.2 capable develop the concept of the project, formulate the goal, objectives, justify the relevance, expected results and scope of their application
		GC-2.3 can develop a project implementation plan taking into account possible risks, plans the necessary resources
GC-7	Able to use digital technologies and methods of searching, processing, analyzing, storing and presenting information (in the field of Ecology and nature management) in the digital economy and modern corporate information culture.	GC-7.1 owns the skills use of digital technologies and search methods,
		GC-7.2 can process, analyze, store and correctly present information
		GC-7.3 knows the principles and techniques of modern corporate information culture and the basics of the digital economy
GPC-5.	Able to solve the problems of professional activity in the field of ecology, nature management and nature protection using information and communication, including geoinformation technologies.	GPC-5.1 Knows how to choose and apply algorithm for solving environmental problems and implements algorithms using software
		GPC-5.2 Has the skills to use information technology tools for searching, storing, processing, analyzing and presenting information
		GPC-5.3 Able to process earth remote sensing data and use cartographic materials, owns modern GIS technologies
PC-4	Ability to use modern methods of processing and interpreting environmental information in scientific and industrial research	PC-4.1 - Know the role and limitations of the use of statistical methods in scientific and practical research
		PC-4.2 - Know computer tools for processing statistical data and solving statistics problems
		PC-4.3 - Be able to formulate the problem of processing real data in terms of mathematical statistics, choose methods for processing statistical data to solve real problems

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

**Know:**

- data processing and visualisation tools in Excel;

- tools and methods of statistical processing of experimental data;
- identification of patterns and forecasting for large and small amounts of data (parametric and non-parametric).

**Be able to:**

- use computer data retrieval tools in the field of production and consumption waste management, their impact on the environment and for the development, examination and implementation of economic activity projects;
- use tools and methods for processing experimental and statistical data, comparing data, searching for patterns;
- use computer tools for this (primarily Excel), interpret the obtained values of parameters and criteria in relation to specific tasks in the field of professional activity.

**Own :**

- methods for assessing the representativeness of the material, sample size when conducting quantitative studies, statistical methods for comparing the data obtained and determining patterns for large and small samples;
- computer programs for processing data arrays, primarily Excel, as well as specialized statistical programs

### 3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

Discipline "IT in ecology and natural resources management" refers to the **mandatory block** parts 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-2 .	Able to manage a project at all stages of its life cycle.	Not	Methodology of Scientific Creation Scientific-research work of graduate students Research work in the term including projects Industrial Internship Undergraduate Internship State Exam Degree Diploma
GC-7 .	Able to use digital technologies and methods of searching, processing, analyzing, storing and presenting information (in the field of Ecology and nature management) in the digital economy	Not	Nature Protection and Accumulated Environmental Damage (AED) Elimination Tools Mapping and GIS-technologies in MSW Management Remote Sensing of MSW objects Scientific-research work of graduate students Research work in the term including projects

Competence code	Competence descriptor	Previous courses/modules, internships*	Subsequent courses/modules, internships*
	and modern corporate information culture.		Industrial Internship Undergraduate Internship State Exam Degree Diploma
<b>GPC-5.</b>	Able to solve the problems of professional activity in the field of ecology, nature management and nature protection using information and communication, including geoinformation technologies.	Not	International cooperation in the field of nature protection / Landscape and geochemical aspects of waste impact Ecotoxicokinetics of waste National and international aspects of radioactive waste management Regional & Municipal MSW Management Systems Biological and sanitary safety of waste management Mapping and GIS-technologies in MSW Management / Remote Sensing of MSW objects / Scientific-research work of graduate students Research work in the term including projects Industrial Internship Undergraduate Internship State Exam Degree Diploma
<b>PC-4</b>	Ability to use modern methods of processing and interpreting environmental information in scientific and industrial research	Not	Scientific-research work of graduate students Research work in the term including projects Industrial Internship Undergraduate Internship State Exam Degree Diploma

#### 4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The course workload of the discipline is **4** credit units

**Table 4.1.**

*Types of educational work by periods of mastering EP VO for full -time education*

Types of academic activities	TOTAL acc.	Semester(s)			
		one	2	3	four
<i>Contact academic hours</i>					
Lectures					
Lab works					
Seminars (workshops/tutorials)	27		27		
<i>Self-study</i>	81		81		

Types of academic activities		Total hours	Semester(s)			
			1	2	3	4
<i>Evaluation and assessment (exam; pass/fail grading)</i>		36	36			
<b>The total course workload</b>	hours	<b>144</b>	<b>144</b>			
	credits	<b>4</b>	<b>4</b>			

## 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. Application of computer technologies in the Practical work of an Ecologist	Topic 1.1. Internet resources containing legal and statistical information. Scientific citation databases and scientific social networks	L
	Topic 1.2. Specialized programs for complex calculations on environmental impact assessment, risk analysis. Software tools for processing text and graphic images	L, S
	Topic 1.3. Application of standard office suite computer programs for solving standard and non-standard practical tasks, performing economic and environmental calculations	
Module 2. Statistical data processing using computer programs	Topic 2.1. Primary processing of statistical data	L, S
	Topic 2.2. Estimation of characteristics of the general population.	L, S
	Topic 2.3. Testing statistical hypotheses.	L, S
	Topic 2.4. ANOVA test	L, S
Module 3. Analysis of experimental data and forecasting	Topic 3.1. Correlation and regression analysis	L, S
	Topic 3.2. Analysis of dynamic series and forecasting	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	Software: Microsoft Windows, MS Office / Office 365, MS Teams, Chrome (latest stable release), Skype. Microsoft Windows 7 corporate. License No. 5190227, date of issue March 16, 2010
Seminars	Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable multimedia projector, laptop, projection screen, stable wireless	
For Self-Study	Classroom for self -study (can be used for	

Classroom for Academic Activity Type	Classroom equipment	Specialized educational / laboratory equipment, software and materials for mastering the course (if necessary)
	seminars and consultations), equipped with a set of devices includes laptop, stable wireless.	MS Office 2007 Prof , License # 6842818, date of issue 09/07/2009

## 7. RESOURCES RECOMMENDED FOR COURSE STUDY

### *Main reading:*

1. Ledashcheva T.N., Pinaev V.E. Computer processing of statistic data: practice. M., RUDN, 2021
2. V. Pinaev, T. Ledashcheva. Environmental impact fee calculation in Russia for EIA – modern practices. 2nd edition. M.: Mir Nauki, 2022. – <https://izdmn.com/PDF/39MNNPU22.pdf>.

### *Additional reading:*

1. P. Golinska, M. Fertsch. Information Technologies in Environmental Engineering 2011. Environmental Science and Engineering, ISSN 1863-5520 Monograph , Electronic resource : <http://www.springerlink.com/openurl.asp?genre=book&isbn=978-3-642-19535-8> Library RUDN University
2. Eric D. \_ Kolaczyk . statistical analysis of network Data [Electronic resource] : Monograph / D . K. \_ Eric . - Electronic text data. - : Springer New York , 2009. Access mode: <http://www.springerlink.com/openurl.asp?genre=book&isbn=978-90-481-3099-3>

### *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](http://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  
ES&PQM Department

**Ledashcheva T.N.**

<div>Position Signature</div> <div><b>HEAD OF DEPARTMENT:</b> Director of ES&amp;PQM Department</div>	<div></div> <div></div>	<div>Name, Surname</div> <div><b>Savenkova E.V.</b></div>
<div>Position</div> <div><b>HEAD OF PROGRAMME:</b> Associate Professor of the ES&amp;PQM Department</div>	<div>Signature</div> <div></div>	<div>Name, Surname</div> <div><b>Popkova A.V.</b></div>
<div>Position</div>	<div>Signature</div>	<div>Name, Surname</div>

# **Department of Environmental Safety and Product Quality Management**

educational department to be specified

APPROVED

Department meeting protocol No \_\_\_\_\_,

Dated \_\_\_\_\_

day, month, year

Head of Educational Department

\_\_\_\_\_(Elena Savenkova)

signature

## **ASSESSMENT TOOLKIT**

**for the course**

IT in ecology and natural resources management

course title

05.04.06 "Ecology and nature management"

field of studies / speciality code and title

Integrated Solid Waste Management»

(Network program with L.N. Gumilyov Eurasian National University)

higher education programme profile/specialisation title

master

graduate's qualification (degree)



## Passport to Assessment Toolkit for Course IT in ecology and natural resources management

Field of Studies / Speciality 05.04.06 Ecology and nature management

code

title

Course: IT in ecology and natural resources management

title

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
			Quiz	Test	Lab work	Homework	Calculation and graphic work	Pass/Fail assessment		
GC-2, GC-7, SPC-5, PC-4	Module 1: Introduction	Topic 1: Computer means of search and data processing. Practical tascs.	1		1	2		`14	4	4
GC-7, SPC-5, PC-4	Module 2: Primary processing of statistical data	Topic 1: Sampling and variation series	1	1	1	2	3		8	16
		Topic 2: Estimates of the characteristics of the general population	1	1	1	2	3		8	
GC-7, SPC-5, PC-4	Module 3: Testing the statistical hypothesis	Topic 1:_Hypothesis about the type of distribution	1	1	1	2	3		8	24
		Topic 2: Hypothesis of equality of averages	1	1	1	2	3		8	
		Topic 3: Hypothesis of equality of variance	1	1	1	2	3		8	
GC-2, GC-7, SPC-5, PC-4	Module 4: Variance analysis	Topic 1:_Parametric variance analysis	1	1	1	2	3		8	16
		Topic 2: Non-parametric variance analysis	1	1	1	2	3		8	
GC-2, GC-7, SPC-5, PC-4	Module 5: Regression analysis	Topic 1: Analysis of correlation	1	1	1	2	3		8	16
		Topic 2: Regression equation	1	1	1	2	3		8	

GC-2, GC-7, SPC-5, PC-4	Module 6: Dynamic series _	Topic 1: Dynamic series analysis and prediction	1	1	1	2	5		10	10
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## QUESTION CARD No

QUESTION 1 Visualization of statistical data.

QUESTION 2 ...Making an interval forecast of the phenomenon for the specified period with a given confidence probability in Excel.

3 \* To compare the two methods of wastewater treatment, the pollutant content was measured after treatment for 80 samples in each case. Are the methods equivalent? Check with Excel

Sample	1 method	2 method	Sample	1 method	2 method
1	3,60	3,73	21	2,79	2,74
2	3,75	4,16	22	4,42	0,17
3	3,30	2,50	23	2,88	3,95
4	4,46	4,01	24	2,75	2,03
5	2,84	5,88	25	1,37	1,31
6	1,42	3,20	26	2,88	2,44
7	3,52	1,73	27	1,86	2,37
8	2,10	4,26	28	1,67	1,89
9	3,41	2,72	29	1,60	1,27
10	3,30	4,71	30	2,87	3,52
11	1,44	3,58	31	2,90	2,43
12	4,38	3,24	32	3,42	3,47
13	1,15	3,08	33	3,60	2,69
14	4,97	2,15	34	3,24	3,60
15	2,07	2,50	35	4,22	2,78
16	3,71	3,44	36	2,54	3,74
17	3,20	1,12	37	4,29	0,98
18	0,95	2,75	38	3,54	2,36
19	1,26	2,68	39	1,34	2,30
20	3,86	3,86	40	3,66	3,48

**Developer** \_\_\_\_\_ (Tatiana Ledashcheva)  
signature

Head of Educational Department \_\_\_\_\_ (Elena Savenkova)  
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)*

### 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	Lab work	The system of practice tasks aimed at the students' practical skills formation	Practice tasks bank
4	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
<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	Homework	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 the teacher 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

# Department of Environmental Safety and Product Quality Management

## Set of tasks for calculation and graphic work

For the course IT in ecology and natural resources management

course title

Task (assignment) 1 Check the hypothesis of the normality of the distribution of the indicator "Change in population size" using statistical data from Russian regions.

Task (assignment) 2 Identify the presence or absence of significant differences in population change over the past year by county by analyzing the data for the federal districts of Russia using analysis of variance and the Kruskal-Wallis criterion. Can we draw conclusions based on the classical analysis of variance here?

Task (assignment) 3 Test the hypothesis about the dependence of changes in population on GRP and emissions to air from stationary sources by selecting the necessary data

Task (assignment) 4 Analyze the dynamics of population change over the past 20 years.

### Assessment criteria:

*(in compliance with the legal regulations in force)*

Developer \_\_\_\_\_ (Tatiana Ledashcheva)  
signature

\_\_\_\_\_  
day, month, year