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

IT in Ecology and Natural Resources Management / Компьютерные технологии и статистические методы в экологии и природопользовании

Recommended by the Didactic Council for the Education Field for the specialization:

05.04.06 "Ecology and Nature Management"

The mastering of the course is carried out as part of the implementation of the main professional syllabus (Higher Education programme, specialization)

Integrated Solid Waste Management / Комплексное управление твердыми бытовыми отходами

2024

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-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 and modern corporate information culture.	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 Industrial Internship Undergraduate Internship State Exam Degree Diploma

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.	Not	International cooperation in the field of nature protection / Landscape and geochemical aspects of waste impact Regional & Municipal MSW Management Systems Biological and sanitary safety of waste management Mapping and GIStechnologies 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
PC-4	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**
Contact academic hours						
Lectures						
Lab works						
Seminars (workshops/tutorials)		68		68		
Self-study		*51*		*51*		
Evaluation and assessment (exam; pass/fail grading)		*25*		*25*		
Total course workload	hours	**144**		**144**		
	credits	**4**		**4**		

5. COURSE CONTENT

Table

5.1. *The content of the discipline (module) by type of educational work*

Title of Course Modules		Content	Types of academic activities
1.	Introduction	Computer means of search and data processing. Practical tascs	S
2.	Primary processing of statistical data	Finding by software the dimension, mean value, fashion, median, standard deviation, dispersion, skewness coefficient, coefficient of variation. Transforming the original data into a ranked series. Interval distribution series. Histograms and polygons of feature distribution frequencies. Determination of the mean and marginal error of a large sample. Required sample size. The concept of a small sample. Determination of the mean and marginal error of a small sample	S
3.	Statistical hypothesis. Testing the statistical hypothesis. Statistical criterion.	The concept of statistical hypothesis. Null and alternative hypotheses. Errors of the first and second kind. Confidence probability and level of significance. Critical region and area of acceptance of the hypothesis. Parametric and non-parametric criteria.	S
4.	Dispersion analysis	The concept and application of dispersion analysis. Oneway analysis of variance: uniform and non-uniform.	S
5.	Correlation and regression.	The concept of statistical connection. Types and forms of connections. Methods for studying statistical communication. Pearson's linear correlation coefficient. Assessment of the significance of the correlation. Confidence interval for the linear correlation coefficient. Rank correlation coefficients. Confidence interval for the regression line at a given significance level. correlation relationship. Determination of the optimal form of communication.	S
6.	Time series analysis and forecasting methods. The study and measurement of seasonal fluctuations	The concept of time series. Their main elements and types of time series. Ways of expressing levels of time series. Graphical analysis of time series. Analytical and average indicators of time series. The main trend of the time series and methods for its detection. Moving average method. Analytical alignment. Cyclical and seasonal fluctuations.	S

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1.

Classroom equipment and technology support requirements

Audience type	Audience equipment	**Specialized educational / laboratory equipment, software and materials for mastering the discipline** (if necessary)

Seminar	Computer class for conducting classes, group and individual consultations, current control and intermediate certification, equipped with personal computers (in the amount of ____pcs), a board (screen) and technical means of multimedia presentations.	A set of specialized furniture; chalk board; hardware: HP PRO system unit, HP-V2072A monitor, LUMIEN retractable projection screen, Internet access. Microsoft Windows 7 corporate. License No. 5190227, date of issue March 16, 2010 MS Office 2007 Prof, License No. 6842818, date of issue 09/07/2009
For independent work of students	An auditorium for independent work of students (can be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to the EIOS.	

7. RECOMMENDED SOURCES FOR COURSE STUDIES

a) **Main reading:**

1. Ledashcheva T.N., Pinaev V.E. Computer processing of statistic data: practice. Moscow, 20 at the department and in electronic form; English translation electronic
2. P. Golinska, M. Fertsch. Information Technologies in Environmental Engineering2011. 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

b) **Additional reading**

1. Ledaschcheva TN, Pinaev VE Environmental impact fee calculation in Russia for EIA – modern practices Print . Textbook - M .: World of Science, 2019. - Access mode: https://izdmn.com/PDF/20MNNPU19.pdf - Head. from the screen. ISBN 978-5-6042807-1-3
2. Kasimov D. V., Ledashcheva T. N., Pinaev V. E. Collection of tasks for environmentalists (HSE specialists). (textbook) Printed. – M.: Mir naGCi, 2019. – (Electronic resource) Access mode: https://izd-mn.com/PDF/19MNNPU19.pdf – Head. from the screen. ISBN 978-5-6042806-9-0
3. Mother Kenneth . statistical analysis in biology [Text] / K . mother . - The book is in English. - London : Methuen , 1965. - 267 p . : il . - Library of RUDN University
4. 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
- 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/
- Google search engine https://www.google.ru/
- abstract database SCOPUS http://www.elsevierscience.ru/products/scopus/

8. MID-TERM ASSESSMENT AND EVALUATION TOOLKIT

Evaluation materials and a point-rating system* for assessing the level of competence formation (part of competences) based on the results of mastering the discipline **IT in Ecology and Natural Resources Management** are presented in the Appendix to this Syllabus.

DEVELOPER:

Associate Professor of the ES&PQM Department		**Ledashcheva T.N.**
Position, BUP	Signature	Name, Surname

HEAD OF DEPARTMENT:

Director of ES&PQM Department		**Savenkova E.V.**
Position	Signature	Name, Surname

HEAD OF PROGRAMME:

Associate Professor of the EM Department		**Kapralova D.O.**
Position	Signature	Name, Surname

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Institute of Environmental Engineering

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

The mastering of the course is carried out as part of the implementation of the main professional syllabus (Higher Education program, specialization)

«Integrated Solid Waste Management / Комплексное управление твердыми отходами»

2024

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			Selfstudies		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			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	`14	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	
		Topic 1:_Parametric variance analysis	1	1	1	2	3		8	16

GC-2, GC-7, SPC-5, PC-4	Module 4: Variance analysis	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

Course IT in ecology and natural resources management
course title

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
		Class work	
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
		Self- studies	
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 evaluateand 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 evaluateand diagnose the students' abilities to synthesise, analyse, generalise factual and theoretical material and formulate specific conclusions, establish causeand-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:**

Associate Professor of the ES&PQM Department		**Ledashcheva T.N.**
Position, BUP	Signature	Name, Surname

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Director of ES&PQM Department		**Savenkova E.V.**
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