

## Syllabus

### Modeling and forecasting of climatic changes

Discipline name:	<b>Modeling and forecasting of climate change</b>
Level of higher education:	<b>second (master's)</b>
Course page in Moodle:	<a href="https://dl.khadi.kharkov.ua/course/view.php?id=2648">https://dl.khadi.kharkov.ua/course/view.php?id=2648</a>
The volume of the educational component	<b>4 credits (120 hours)</b>
Form of final control	<b>offset</b>
Consultations:	<b>on schedule</b>
Name of the department:	<b>Department of Ecology</b>
Language of instruction:	<b>english</b>
Course leader:	<b>Kalyuzhnaya Julia Sergeevna, candidate of technical sciences.</b>
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#### Summary of the educational component:

**The aim** is to study and obtain systemic ideas about the natural and anthropogenic causes of modern global changes in the natural environment, the main factor of which is climate warming, clarifying their dynamics, impact on the natural environment and studying ways to possibly prevent the consequences of their development in the future. Master-ecologist should have a good idea of the causes of modern climate change, the mechanism of their impact on environmental components and anticipate possible consequences of such an impact.

**Subject:** methodology and organization of research on the impact of modern climate change.

#### The main tasks of studying the discipline are:

- formation of an integrated system of knowledge among applicants regarding the methodology and organization of research on the impact of modern climate change;
- assimilation by applicants of the elements of research activities, principles of organization, methods and technologies of research under the influence of climate change;
- formation of views on the nature and causes of the evolution of the global climate in the past and in the modern era, as well as general ideas about expected climate change in the future and related geosphere trends.
- monitoring the state of the environment, modeling and forecasting the processes that occur in the environment.

#### Prerequisites for studying the educational component:

1. The presence of OS "Bachelor" in a related specialty 2. Availability of OS "Bachelor" in an unrelated specialty (with the preparation of an additional entrance test).

#### Competences that the applicant acquires:

##### **Integral competence:**

K1 Ability to solve complex problems and problems in the field of ecology, environmental protection and balanced environmental management in the implementation of professional activities or in the learning process, which involves research and / or innovation, and is characterized by complexity and uncertainty of conditions and requirements.

##### **General competencies:**

ZK04 – Ability to develop and manage projects.

**Special (professional) competencies:**

FC05 – ability to bring knowledge and own conclusions to specialists and non-specialists;

FC07 – ability to organize work related to environmental assessment, environmental protection and optimization of environmental management, in conditions of incomplete information and conflicting requirements;

FC08 – ability to self-education and advanced training based on innovative approaches in the field of ecology, environmental protection and balanced environmental management;

FC10 – ability to assess the level of negative impact of natural and anthropogenic factors of environmental hazard on the environment and humans;

FC12 – Ability to develop and implement a set of works to prevent, adapt and minimize the effects of climate change.

**Learning outcomes in accordance with the educational program:**

PR02. Be able to use conceptual environmental patterns in professional activities.

PR09. Know the principles of personnel and resource management, basic approaches to decision-making in conditions of incomplete / insufficient information and conflicting requirements.

PRN22. Be able to develop and implement a set of works to prevent, adapt and minimize the effects of climate change.

**Thematic plan**

Topic number	Title of topics (LK, LR, PR, SZ, WED)	Number of hours	
		Eye	Correspondence
1	LC Introduction. Climate. Types of manifestation of modern changes in the natural environment. Global climate change	4	2
	PR (LR, SZ) Principles of construction of modern climate models	2	2
	CP Historical dynamics of climatic processes	9	14
2	LC Modern climate of Ukraine and its geological and historical changes.	4	2
	PR (LR, SZ) Comparative analysis of global and regional climate models.	2	2
	CP The role of geological processes in global climate change	9	14
3	LC Physical, mathematical and statistical models of climate. Global models in the study of the current climate and its future changes	4	2
	PR (LR, SZ) Application of long-term models to identify trends and assess the effects of environmental and climate change	2	
	CP The role of evolutionary processes in local climate change	9	14
4	LC Individual regional models and their ensembles	4	2
	PR (LR, SZ) Assessing the city's vulnerability to climate change	2	
	CP Risks of Climate Change in Ukraine	9	14

5	LC Using electronic databases to verify the model results of climate change	4	
	PR (LR, SZ) <u>Adaptation of biodiversity to climate change</u>	2	
	CP Using Satellite Data to Predict Climate Change	9	14
6	LC Forecast of climatic indicators: projections of ground air temperature for the territory of Ukraine in the XXI century	4	
	PR (LR, SZ) Adaptation of agriculture to climate change.	2	
	CP Climate Change Adaptation Tools	9	14
7	LC Approaches and methods for modeling greenhouse gas emissions.	4	
	PR (LR, SZ) Modeling and spatial analysis of greenhouse gas emissions arising from the extraction and processing of various fuels	4	
	CP Joint Implementation Projects to Tackle Climate Change	9	12
8	LC Geoinformation technology of spatial modeling of greenhouse gas emission processes.	4	
	PR (LR, SZ) -		
	CP Legislation of Ukraine in the field of climate change	9	12
<b>Together</b>	LUKE	32	8
	PR (LR, SZ)	16	4
	WED	72	108

**Individual educational and research task (if any):**

**Teaching Methods:**

- 1) verbal: 1.1 traditional: lectures, explanations, narration, etc.;
- 1.2 interactive (non-traditional): problem lectures, discussions, etc.;
- 2) visual: the method of illustrations, the method of demonstrations
- 3) practical: 3.1 traditional: practical classes, seminars;
- 3.2 interactive (non-traditional): business and role-playing games, trainings, discussion seminars, "round table", brainstorming method.

**Grading system and requirements:**

**Current success**

**1** The current success of applicants for the performance of educational types of work in training sessions and for the performance of tasks of independent work is assessed using a four-point scale of grades, followed by recalculation in a 100-point scale. When assessing current performance in are counted all types of work provided by the training Program.

**1.1** Lectures are evaluated by determining the quality of the specified tasks.

**1.2** Practical classes are assessed by the quality of the control or individual task, the performance and design of practical work.

1.3 Laboratory classes are assessed by the quality of the implementation of reports on the performance of laboratory work.

1.4 Seminars are evaluated by the quality of the individual task / abstract.

2 Evaluation of the current performance of applicants for higher education is carried out at each practical lesson (laboratory or seminar) on a four-point scale ("5", "4", "C", "2") and are recorded into Logbook Academic Success.

– "excellent": the applicant perfectly assimilated theoretical material, demonstrates deep knowledge of relevant topic or academic discipline, main provisions;

- "good": the applicant has well mastered the theoretical material, owns the main aspects from the primary sources and the recommended literature, argues mentally teaches it; has practical skills, expresses his reasoning about certain problems, but assumes certain inaccuracies and errors in the logic of presentation of theoretical content or in the analysis of practical;

- "satisfactory": the applicant has mainly mastered the theoretical knowledge of an academic topic or discipline, is guided in primary sources and the recommended literature of RI, but unconvincingly answers, confuses concepts, uncertainly answers additional questions, does not have stable knowledge; answering questions of a practical nature, reveals inaccuracies in knowledge, does not know how to evaluate facts and phenomena, connect them with a future profession;

– "unsatisfactory": the applicant has not mastered the educational material of the topic (discipline), does not know scientific facts, definitions, is almost not oriented in primary sources and recommended literature, there is no scientific thinking, practical skills are not formed.

3 Final score per current activity is recognized as arithmetic mean Amount points for each lesson, for individual work, current tests According to the formula:

$$K^{nomoch} = \frac{K1+K2+...+Kn}{n},$$

де  $K^{nomoch}$  – final assessment of success based on the results of current control;

$K1, K2, \dots, Kn$  – evaluation of success  $n$ -th measure of current control;

$n$  – the number of measures of current control.

Prices are converted into points according to the recalculation scale (Table 1).

**Table 1** – Recalculation of the average score for current activities in a multi-point scale

4-point Scale	100- point Scale	4- point Scale	100- point Scale	4- point Scale	100- point Scale	4- point Scale	100- point Scale
5	100	4,45	89	3,90	78	3,35	67
4,95	99	4,4	88	3,85	77	3,3	66
4,9	98	4,35	87	3,80	76	3,25	65

4,85	97	4,3	86	3,75	75	3,2	64
4,8	96	4,25	85	3,7	74	3,15	63
4,75	95	4,20	84	3,65	73	3,1	62
4,7	94	4,15	83	3,60	72	3,05	61
4,65	93	4,10	82	3,55	71	3	60
4,6	92	4,05	81	3,5	70	from 1,78 to 2,99	from 35 to 59
Reassembly							
4,55	91	4,00	80	3,45	69	from 0 to 1,77	from 0 to 34
4,5	90	3,95	79	3,4	68	Re-study	

## Final assessment

**1** Applicant for higher education Gets credit upon Last Lesson with Discipline per the results of the current assessment. Average score for current activities is converted into points on a 100-point scale, according to the table Recalculation (Table 1). Applicants for higher education Education who have an average Current Assessment with disciplines lower than "3" (60 points), upon Last classes can increase their current score by taking tests with Discipline.

Assessment of knowledge of applicants by testing is carried out on a scale:

- "Excellent": at least 90% of correct answers;
- "Very good": from 82% to 89% of correct answers;
- "Good": from 74% to 81% of correct answers;
- "Satisfactory": from 67% to 73% of correct answers;
- "Satisfactory enough": from 60% to 66% of correct answers;
- "Unsatisfactory": less than 60% of correct answers.

**2** Condition of receipt The standings are:

- working out all missed Classes;
- the average current grade in the discipline is not lower "3" (60 points).

**3** For the implementation of individual independent work and participation in scientific events, applicants are awarded additional points.

**3.1** Additional points are added to the sum of points scored muffinhigher education for current academic activities (for disciplines for which the final form of control is credit), or to the final grade with discipline, the final form of control for which is the exam.

**3.2** The number of additional points awarded for different types of individual tasks depends on their volume and significance:

- prizes in the discipline at the international / all-Ukrainian competition of scientific student works – 20 points;
- prizes in the discipline at the All-Ukrainian Olympiads – 20 points;
- Participation in the international / All-Ukrainian competition of scientific student works – 15 points
- participation in international / all-Ukrainian scientific conferences of students and young scientists – 12 points;
- Participation in all-Ukrainian Olympiads in the discipline – 10 points
- participation in olympiads and scientific conferences of KhNADU in the discipline – 5 points;

– implementation of individual research (educational and research) tasks of increased complexity – 5 points.

**3.3** The number of additional points may not exceed 20 points.

**4** The result of training is evaluated (*choose the right one*):

– per two-point scale (credited/not enrolled) according to Table 2;

– on a 100-point scale (for differentiated standings) according to Table 3.

The final score, together with additional points, cannot exceed 100 points.

**Table 2** – Scale of transfer of points to the national grading system

On a 100-point scale	On a national scale
from 60 points to 100 points	enrolled
less than 60 points	unaccounted for

**Table 3** – Scale of assessment of applicants' knowledge based on the results of the final control in the discipline

Score in points	National scale score		ECTS score	
	Exam	Passed	Score	Criteria
<b>90-100</b>	<b>Perfectly</b>	<b>Enrolled</b>	<b>A</b>	The theoretical content of the course is mastered entirely, without gaps, the necessary practical skills of working with the mastered material are formed, all the training tasks provided by the training program have been completed, the quality of their implementation is estimated by the number of points close to the maximum
<b>80-89</b>	<b>Well</b>	<b>Enrolled</b>	<b>B</b>	The theoretical content of the course is mastered entirely, without gaps, the necessary practical skills in working with the mastered material are mainly formed, all the training tasks provided by the training program have been completed, the quality of most of them is estimated by the number of points close to the maximum
<b>75-79</b>			<b>C</b>	The theoretical content of the course is mastered entirely, without gaps, some practical skills of working with the mastered material are not sufficiently formed, all the training tasks provided by the training program have been completed, the quality of none of them is assessed by the minimum number of points, some types of tasks are performed with errors

Score in points	National scale score		ECTS score	
	Exam	Passed	Score	Criteria
67-74	Satisfactory		<b>D</b>	The theoretical content of the course is partially mastered, but the gaps are not significant, the necessary practical skills in working with the mastered material are mainly formed, most of the training tasks provided by the training program have been completed, some of the tasks performed may contain errors
60-66			<b>E</b>	The theoretical content of the course is partially mastered, some practical skills of work are not formed, many of the training tasks provided by the training program have not been completed, or the quality of some of them is estimated by the number of points close to the minimum.
35-59	Disappointing	Not credited	<b>FX</b>	The theoretical content of the course is partially mastered, the necessary practical skills of work are not formed, most of the provided training programs have not been completed, or the quality of their implementation is estimated by the number of points close to the minimum; with additional independent work on the course material, it is possible to improve the quality of the training tasks (with the possibility of re-compilation)
0-34			<b>F</b>	The theoretical content of the course has not been mastered, the necessary practical skills of work are not formed, all completed training tasks contain gross errors, additional independent work on the course material will not lead to any significant improvement in the quality of the training tasks (with a mandatory repeated course)

### Course Policy:

- the course involves teamwork, the environment in the audience is friendly, creative, open to constructive criticism;
- mastering the discipline involves the obligatory attendance of lectures and practical classes, as well as independent work;
- independent work involves the study of individual topics of the discipline, which are made in accordance with the program for independent study, or were considered briefly;
- all tasks envisaged by the program must be completed within the prescribed period;
- if the applicant for higher education is absent from the classroom for a good reason, he presents the completed tasks during the independent preparation and consultation of the teacher;

- course work must be protected no later than a week before the start of the examination session (**indicated if available**);
- while studying the course, applicants for higher education must comply with the rules of academic integrity set forth in the following documents: "Rules of academic integrity of participants in the educational process of KhNADU" ([https://www.khadi.kharkov.ua/fileadmin/P\\_Standart/pologeniya/stvnz\\_67\\_01\\_dobroch\\_1.pdf](https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_dobroch_1.pdf)), "Academic integrity. Verification of the text of academic, scientific and qualification works for plagiarism" ([https://www.khadi.kharkov.ua/fileadmin/P\\_Standart/pologeniya/stvnz\\_85\\_1\\_01.pdf](https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_85_1_01.pdf)), "Moral and ethical code of participants in the educational process of KhNADU" ([https://www.khadi.kharkov.ua/fileadmin/P\\_Standart/pologeniya/stvnz\\_67\\_01\\_MEK\\_1.pdf](https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_MEK_1.pdf)).
- in case of detection of the fact of plagiarism, the applicant receives 0 points for the task and must re-complete the tasks provided for in the syllabus;
- write-offs during tests and exams are prohibited (including using mobile devices). Mobile devices are only allowed to be used during online testing.


**Recommended literature:** (*literature no later than 10 years, except for 1 fundamental classical textbook or monograph*)

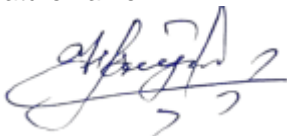
1. Greenhouse effect and climate change in Ukraine: assessments and consequences / ed. Lyalka V.I. – Kyiv: SPE "Publishing House "Naukova Dumka" of the National Academy of Sciences of Ukraine", 2015. – 283 p.
2. Boichenko S.G. Semi-empirical models and scenarios of global and regional climate change: monograph / NAS of Ukraine; Institute of Geophysics. S.I. Subbotina / V.M. Voloshchuk (ed.). - K. : Naukova Dumka, 2008. — 309 p.
3. Rapsun M.V., Trofimchuk O.M., Surnin S.B., Kiyashko G.A., Weinstein G.L. Sources of greenhouse gas emissions and measures to mitigate climate change in the infrastructure of Ukrainian cities: Pilot project in Rivne / Agency for Rational Use of Energy and Ecology (ARENA-ECO); Ukrainian Institute of Environmental and Resource Research (UIDSR) / Mykola Vitaliyovych Rapsun (ed.), Oleksandr Trofimchuk (ed.). - K., 2003. — 146 p.
4. Regional climate change of Ukraine: Methodical instructions for the training course for students of the Faculty of Geography of the specialty "Meteorology and Climatology" / ucl. L.V. Palamarchuk, S.V. Krakovska. – K. : Print-Service, 2018. – 90 p.

**Additional Sources:**

1. Distance course:  
<https://dl.khadi.kharkov.ua/course/view.php?id=26486>
2. Analytical review of the state of technogenic and natural safety in Ukraine for 2018. [Electronic resource]. – Access mode:  
<https://www.dsns.gov.ua/files/prognoz/report/2018/rozdil2.pdf>
3. <http://www.nbu.gov.ua/> – site of the Vernadsky National Library
4. <http://www.gasac-americas.org>. - Chemistry of precipitation (WDCPC)

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